NOVEMBER 1959—SIXTY-SIXTH YEAR

Machinery

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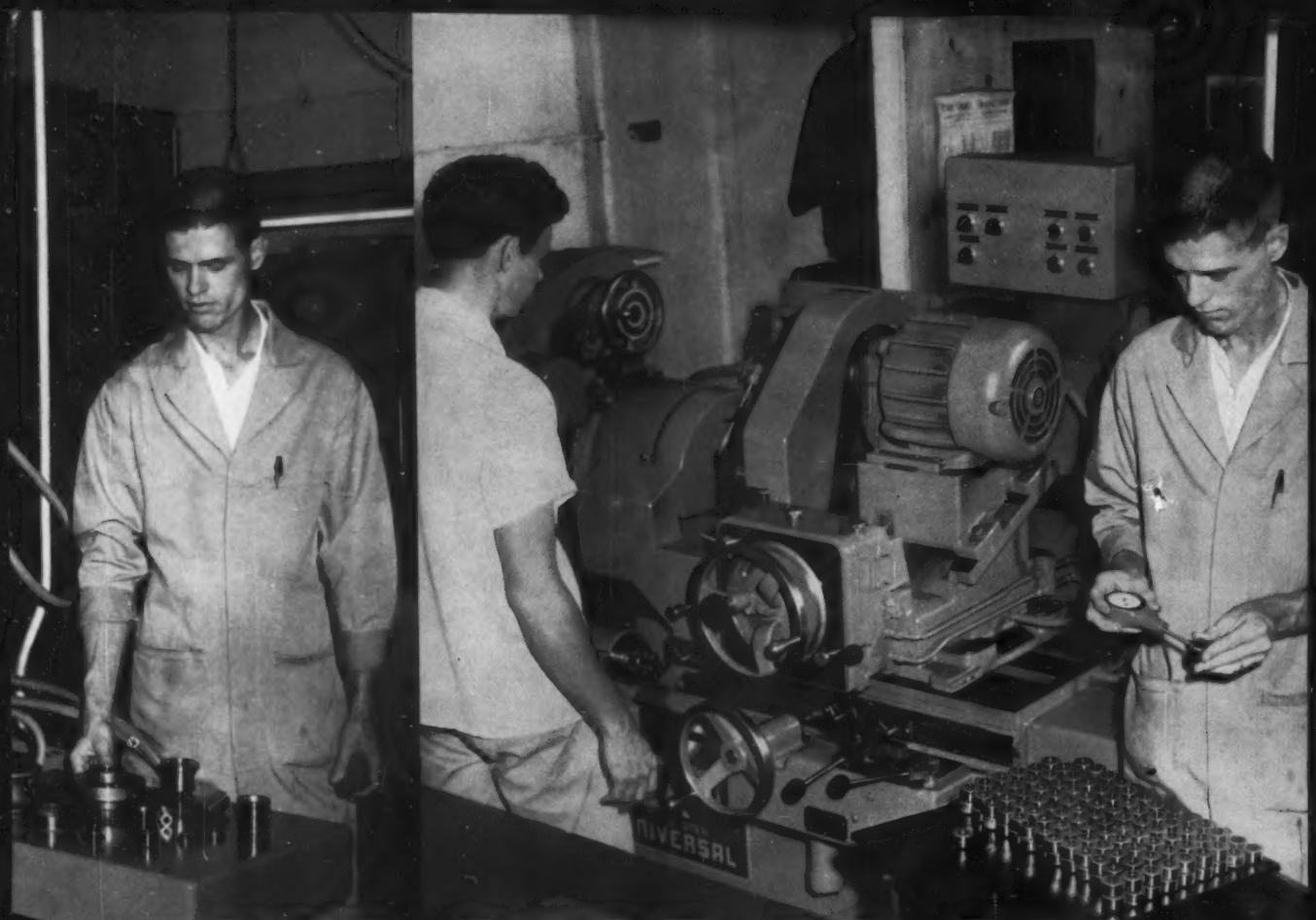

ONE PART OR 500

Selco gets top grinding performance at rock-bottom cost with the

NEW HEALD MODEL 273A UNIVERSAL

The Heald Model 273A Universal Internal Grinder shown above is installed at the Selco Grinding Company — a small but busy job shop in southern California. Here it is used to grind straight or tapered I.D.s and O.D.s, and for rotary surface grinding of flat, convex or concave surfaces of a wide range of work — from individual parts to production runs. And it easily handles every job with far greater speed, accuracy, precision and finer finish than could be obtained on any of their previous equipment.

Until the advent of this Universal Grinder, most small job shops (and many larger ones, too) couldn't afford a machine of this type. But the Heald 273A costs about *half* as much as comparable machines today, and less than similar machines (with fewer features) cost in 1947!

Incorporating the latest advances in the grinding art, it holds tolerances to within .0001″ in routine production, and within .000050″ in special cases. Features include hydrostatic antifriction ways, full 20″ table travel, several wheelhead positions, infinitely variable workhead speed from 150 to 450 rpm and 90 degree workhead swivel for rotary surface grinding.

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HEALD

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NOVEMBER 1959

VOL. 66 No. 3

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BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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"Delivery as promised" is an important part of LANDIS Service to its customers. A delivery date is a promise—important to the customer—and therefore important to us.

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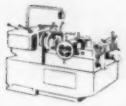
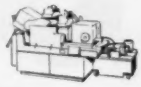
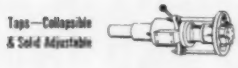


Threading Machines

Die Heads—Rotary & Stationary

Centerless Thread Grinding Machines

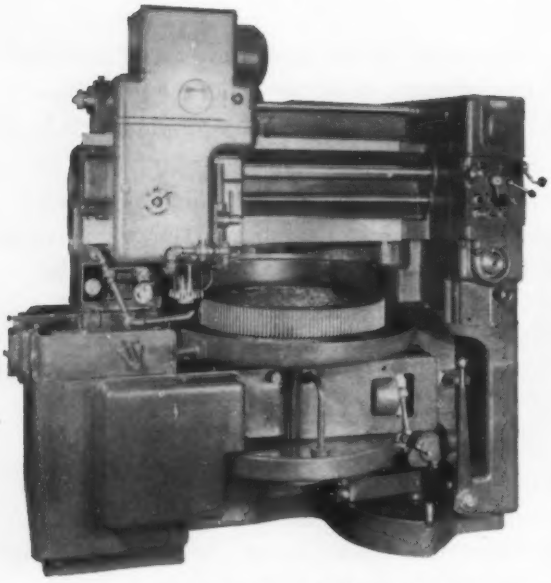




Taps—Collapsible & Solid Adjustable

Thread Rolling Machines

Thread Rolling Tools



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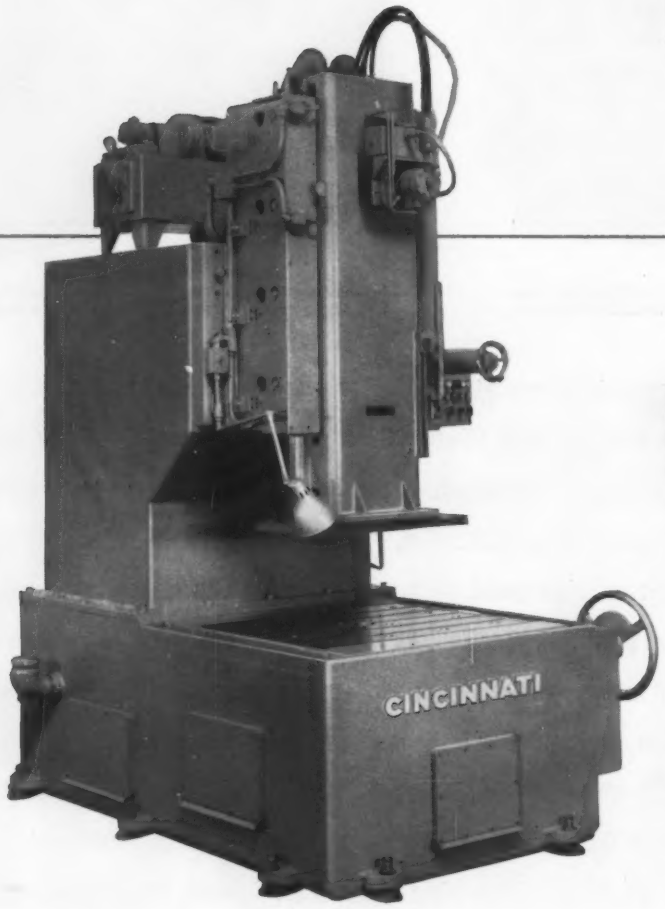

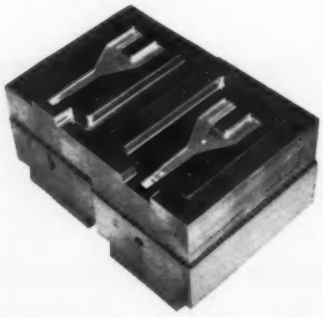

NO. 3 ELEKTROJET. This machine has the capacity for large heavy work, like the 15" long dies illustrated here.

BUILDERS OF FINE MACHINE TOOLS: KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES •

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ELECTRICAL-DISCHARGE MACHINE

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Advantages offered by electrical discharge machining are greatly extended by Cincinnati's new line of Elektrojet Machines. There are 35 variations in the line, covering the requirements for unusual or "impossible" machining operations on a wide variety of parts ranging from small missile components to forging dies. Elektrojet Machines are designed from the machine tool builder's viewpoint, with a high degree of dependable performance in mind.

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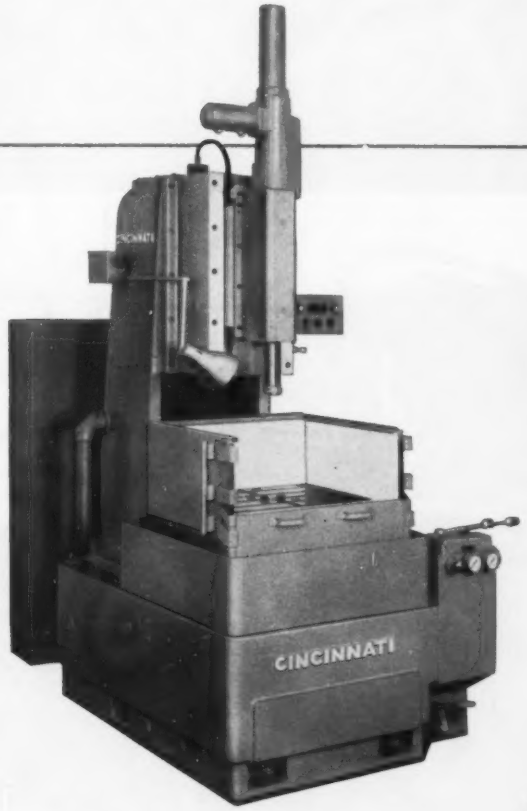

No. 1 ELEKTROJET with non-rotating workhead. Typical work is the extrusion die shown above, about 2⅞" outside diameter. Operation, EDM gear teeth through center.

CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

CINCINNATI®
MILLING MACHINE DIVISION

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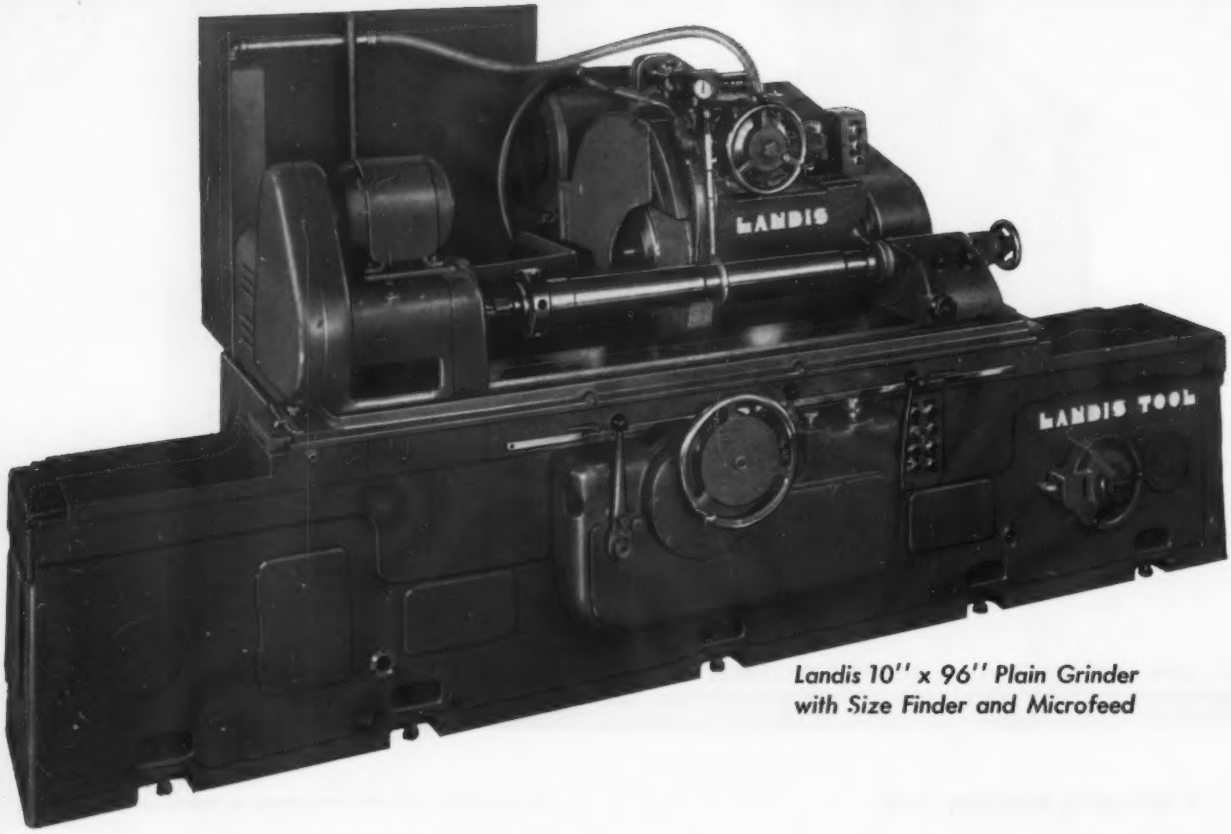
LANDIS size finder with MICROFEED

Positive direct reading size finder cuts setup time

Landis MICROFEED assures "tenths" tolerances consistently

Eliminates costly rejects

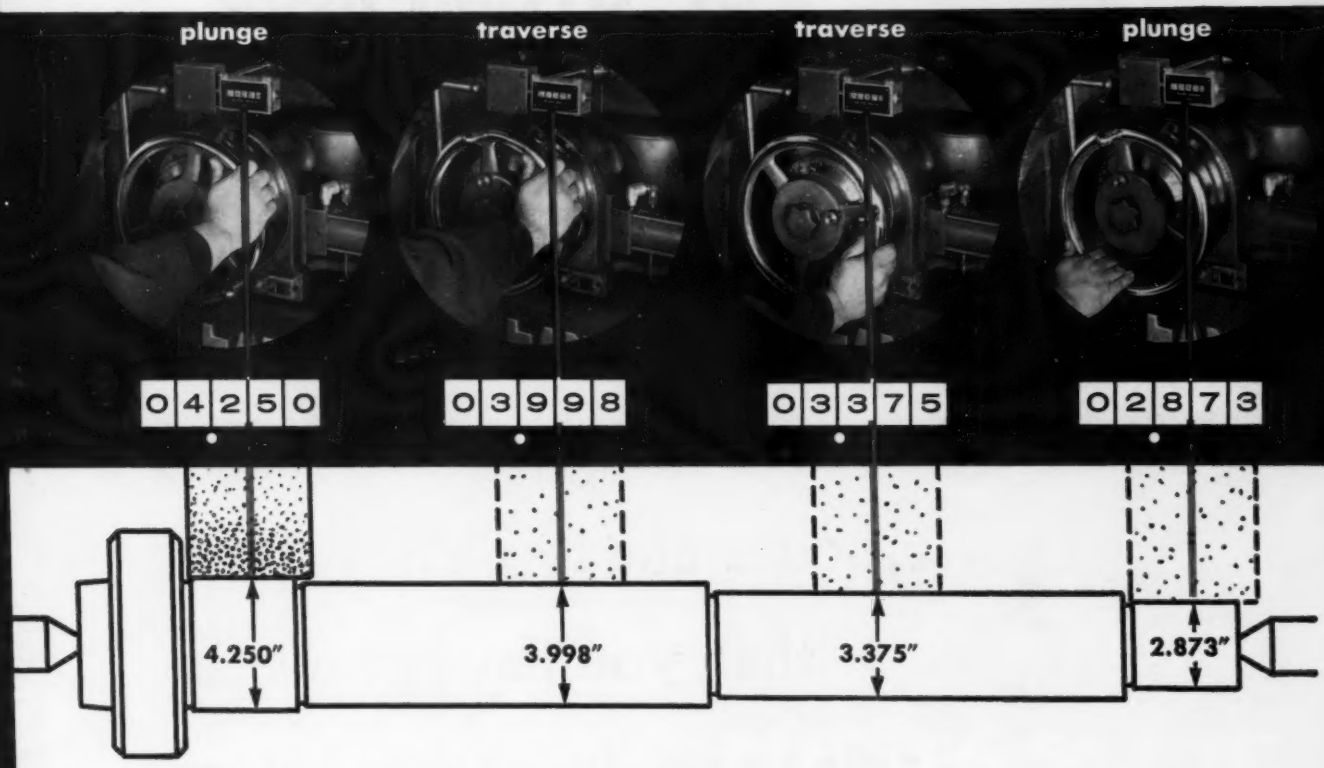


Landis 10" x 96" Plain Grinder with Size Finder and Microfeed

# of grinding shafts

shows remarkable savings on small lots

finish sizes set on direct reading dial



how size finder works

The operation of the machine is simple, even for unskilled operators. It's only necessary to set the finish dimension on the indicator by turning the wheel feed handwheel. Operator starts the cycle, applies the sizing gauge and stops the cycle when the gauge shows finish size. He moves the work table, resets the Size Finder for the next diameter and repeats the cycle.

You can make large savings on your small lot multiple diameter shaft grinding operations. Send us prints of your shafts for our proposal.

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precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

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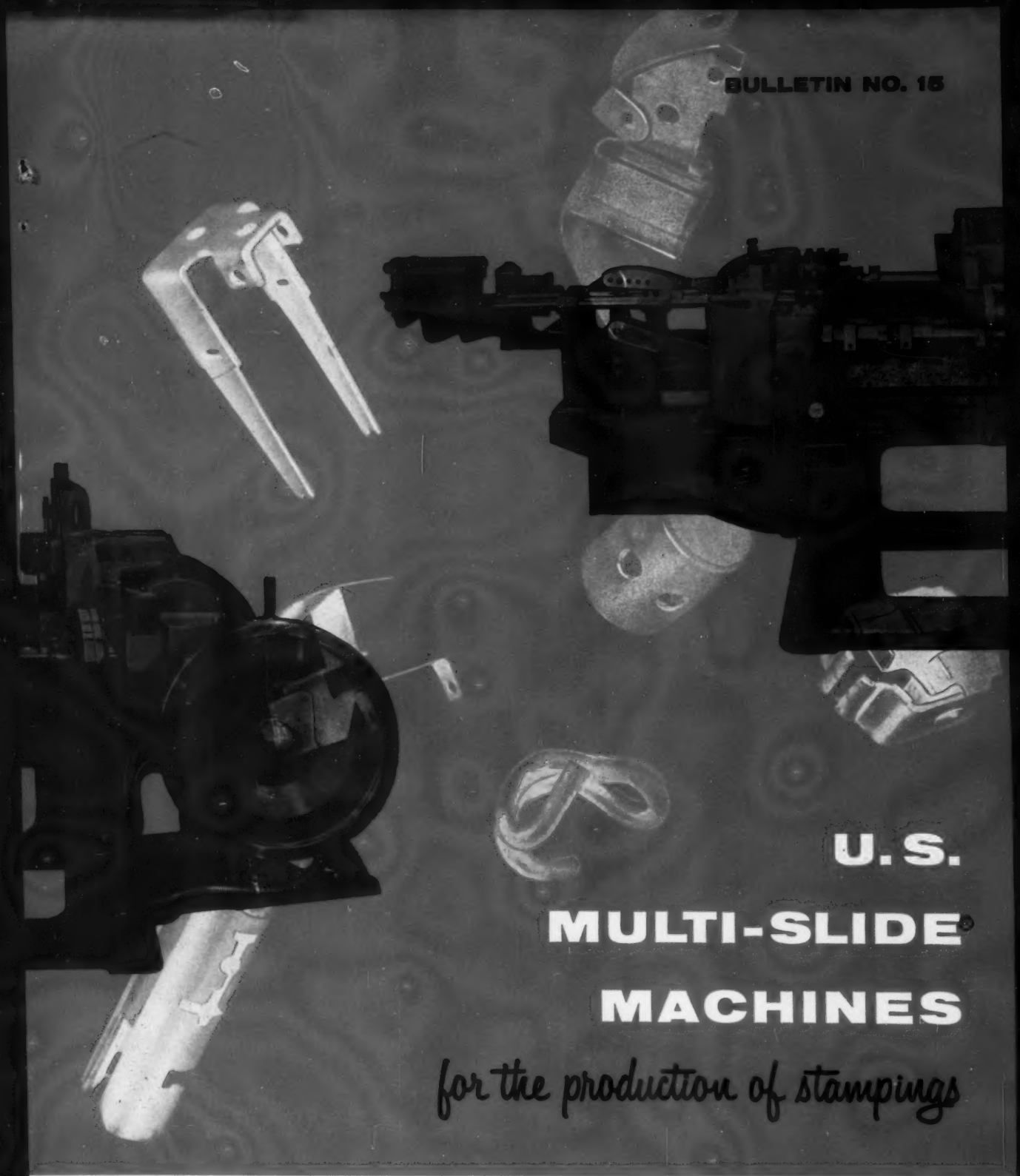

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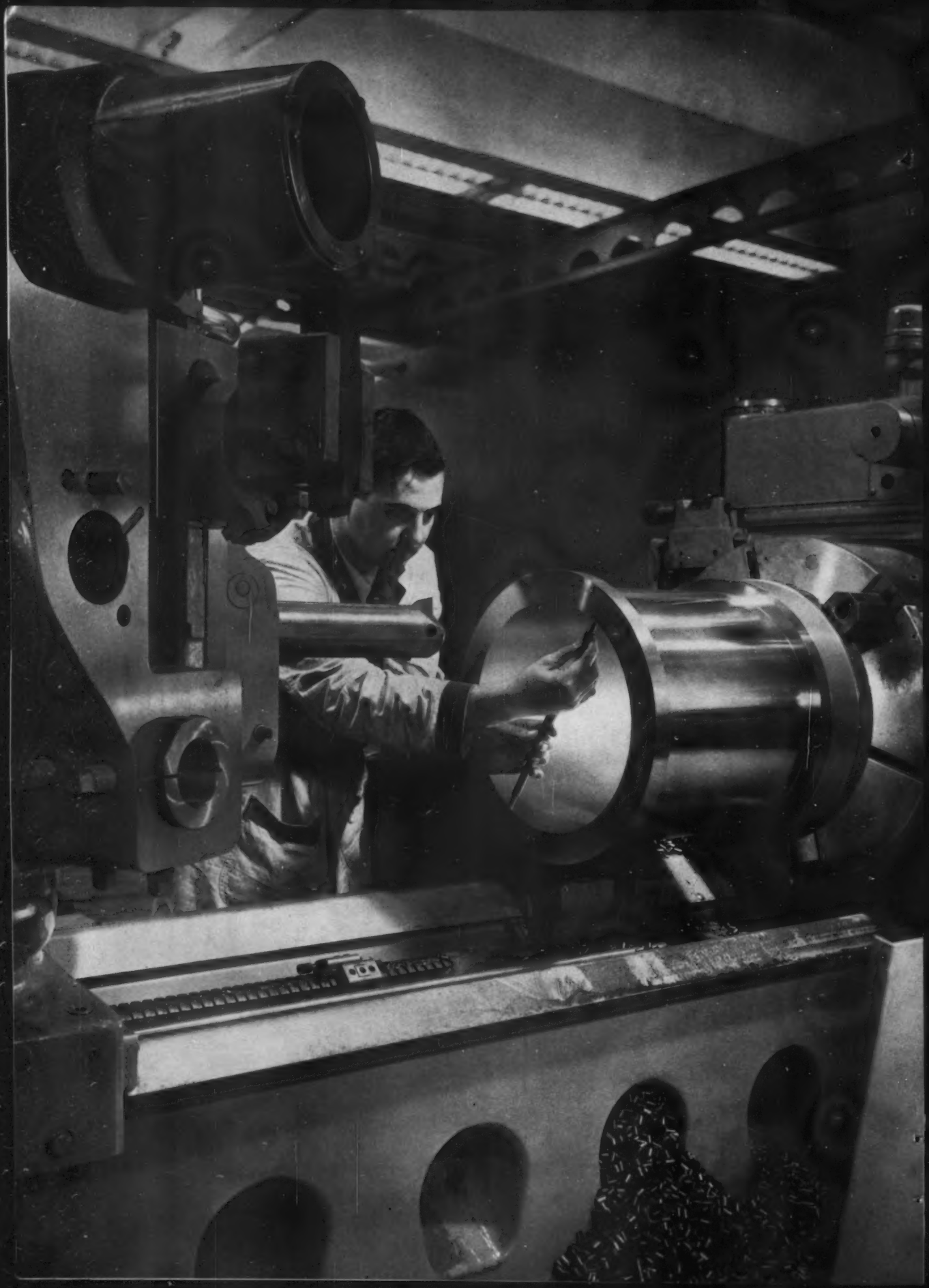


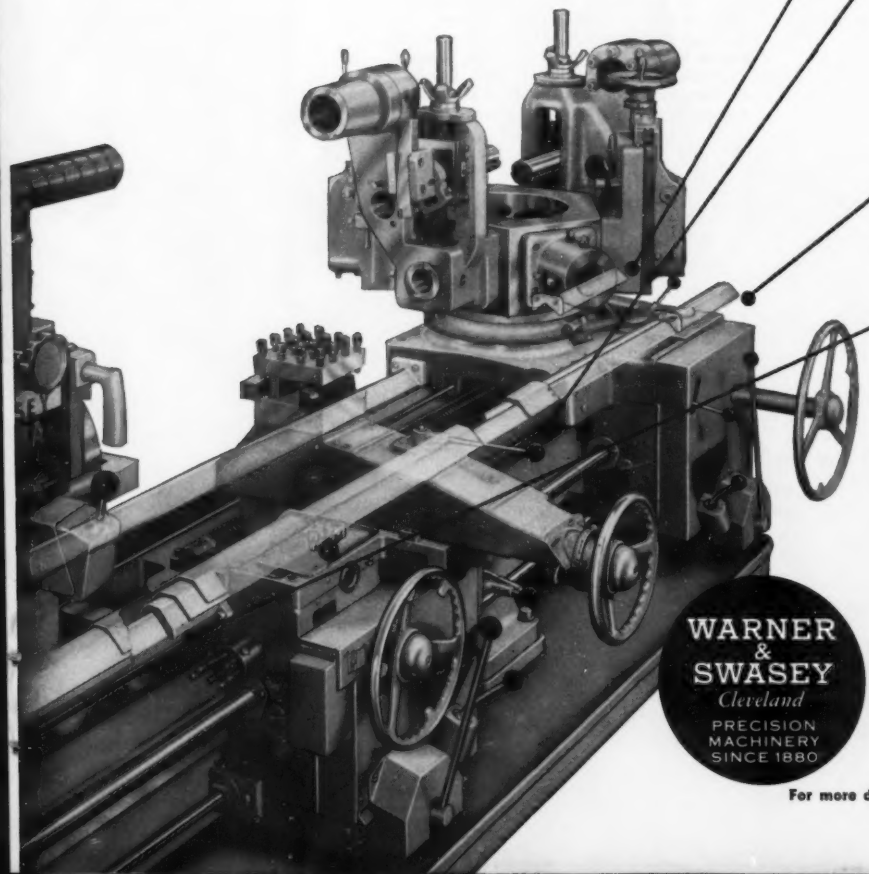
VEE-WAY ACCURACY and EASE OF OPERATION

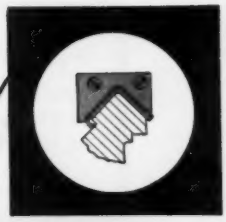
preserved by Warner & Swasey's telescoping way covers

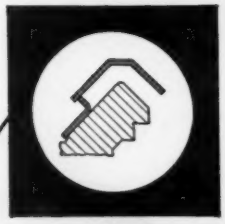
Regardless of carriage or saddle positions on the bed, Warner & Swasey's patented Telescoping Way Covers provide complete bedway protection. Tools, gritty materials, cutting fluids, even heavy workpieces can fall on the Way Covers but the accuracy and free-sliding smoothness of Warner & Swasey's exclusive self-guiding Vee-Ways are fully protected throughout years of hard use . . . and with a minimum of maintenance. As a result, dependable, close-tolerance performance is easy to maintain without fighting or pampering the machine.

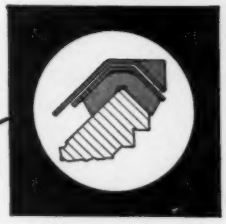
With Warner & Swasey Saddle Type Turret Lathes, operators stand closer and more comfortably to their work. That's because strength and rigidity of the bedways are achieved through scientific cross-rib construction instead of by mere mass and width of the bed. They report their Warner & Swaseys are easier to handle because all movable units slide on well-lubricated bearing surfaces—enclosed and protected at all times by the patented Telescoping Way Covers.

When operators like the equipment on which they work—production increases. So, why not let our Field Representative show you all the operator advantages designed into Warner & Swasey Turret Lathes? It can save you money.









These exclusive Telescoping Way Covers fully protect the bedways from accidental dropping of heavy objects. Chips cannot work between the Ways and carriage or saddle units to damage important bearing surfaces. Flooding coolant cannot wash away vital lubricant or combine with dust and oil to gum up bearing surfaces.

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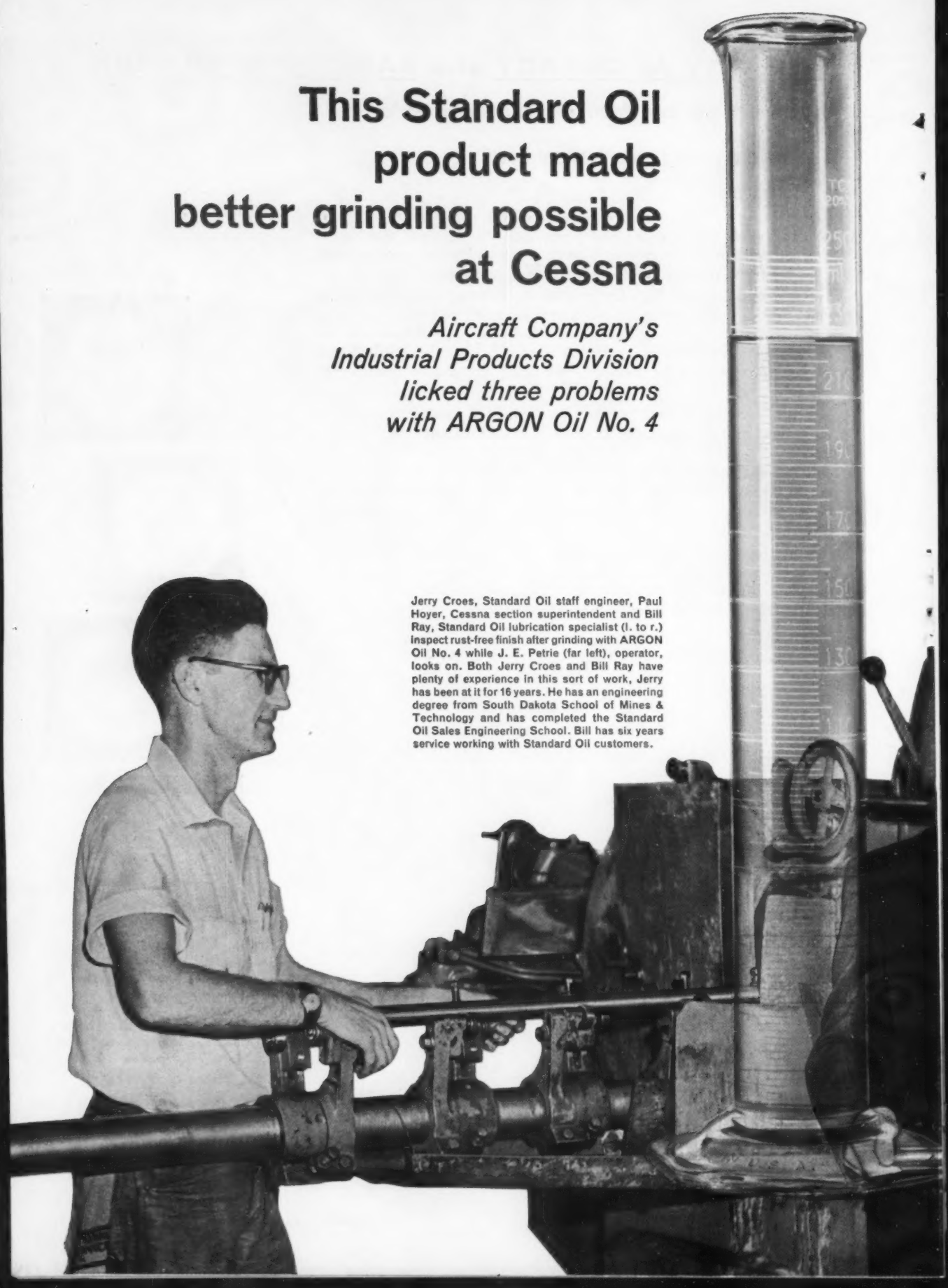
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

This Standard Oil product made better grinding possible at Cessna

Aircraft Company's Industrial Products Division licked three problems with ARGON Oil No. 4



Jerry Croes, Standard Oil staff engineer, Paul Hoyer, Cessna section superintendent and Bill Ray, Standard Oil lubrication specialist (l. to r.) inspect rust-free finish after grinding with ARGON Oil No. 4 while J. E. Petrie (far left), operator, looks on. Both Jerry Croes and Bill Ray have plenty of experience in this sort of work, Jerry has been at it for 16 years. He has an engineering degree from South Dakota School of Mines & Technology and has completed the Standard Oil Sales Engineering School. Bill has six years service working with Standard Oil customers.

Situation: A fluid used in grinding operations at this Cessna plant at Hutchinson, Kansas, was creating three problems:

1) It washed the lubricant from regulator wheels and grinding fixtures, causing them to freeze.
2) It caused build-up of deposits.
3) It stripped paint from machine surfaces.

What was done: Cessna management called in a Standard Oil lubrication specialist who recommended ARGON Oil No. 4 in ratios of 100 and 150:1 for test. The coolant was tested in two centerless grinders for two months.

What happened: All three conditions which were hampering operations were cleared up when the switch was made to ARGON Oil No. 4. Cessna also found that work remained rust-free after passing through the machines, something that had not been the case before. They also found that the coolant didn't foam. With no foam, more of it stayed on the wheel, resulting in cooler operation. Faster cuts were obtained with finer wheels. All 12 grinders in the Cessna shop were then converted to ARGON Oil No. 4.

What you can do: Get more facts about ARGON Oil No. 4 from the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.**

Quick facts about **ARGON Oil No. 4**

• Clear, transparent fluid • Able to control corrosion and rust on work and machines • All chemical. Does not support bacteria growth • Unaffected by humidity • Fire resistant • Odorless

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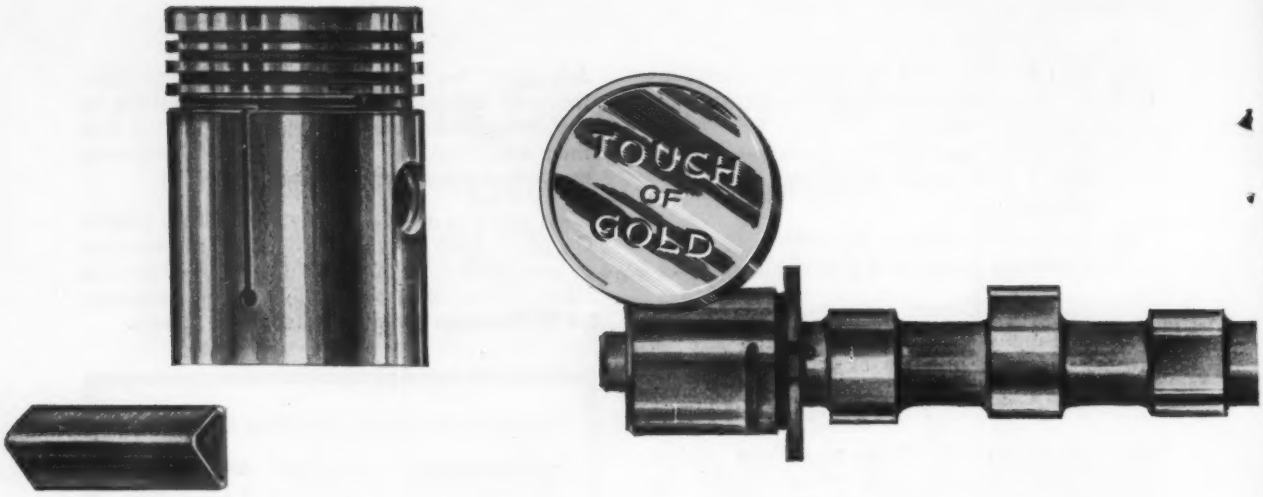
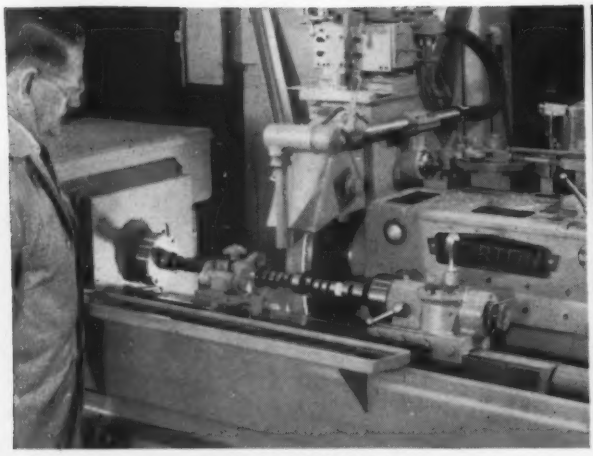
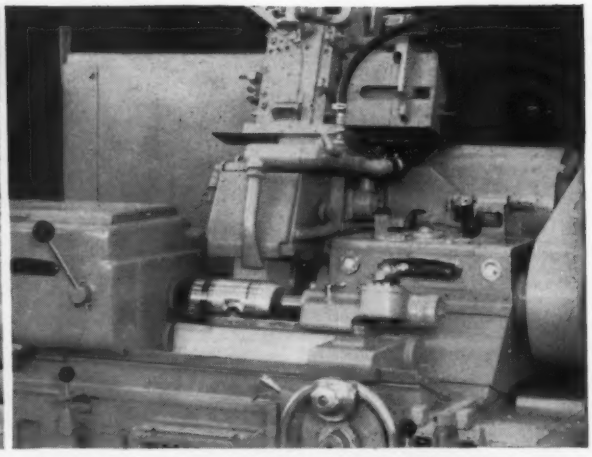


If you grind
special shapes . . . like these

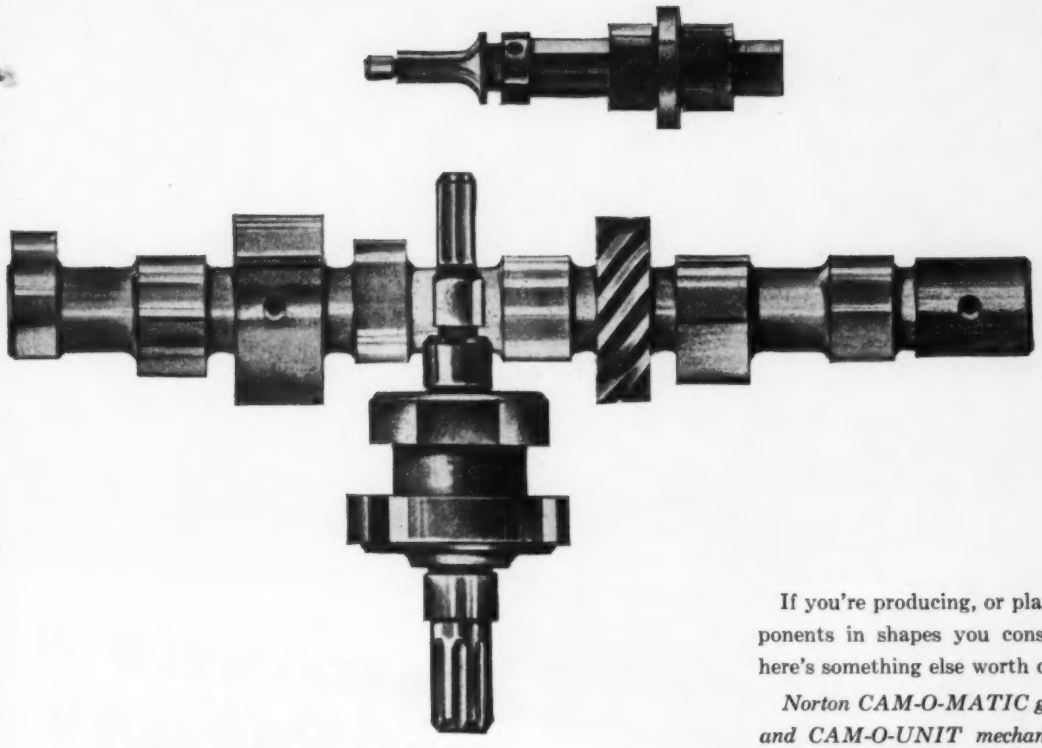
Check the special advantages of Norton grinders . . .



With a Norton No. 3 CAM-O-MATIC* Grinder, you grind all cams and the eccentric on an automotive-type camshaft automatically, in one handling. Automatic wheel truing and a patented device for grinding cam tapers in one or both directions are among the features that improve contour, finish and production rate.



A Norton 6″ x 8″ Semiautomatic Piston Grinder adds extra speed and economy to your grinding of elliptical pistons. Mechanism arrangements enable you to grind complex ovality into the skirt of a piston, as shown, or to produce standard ovality or different amounts of relief over a wide range.



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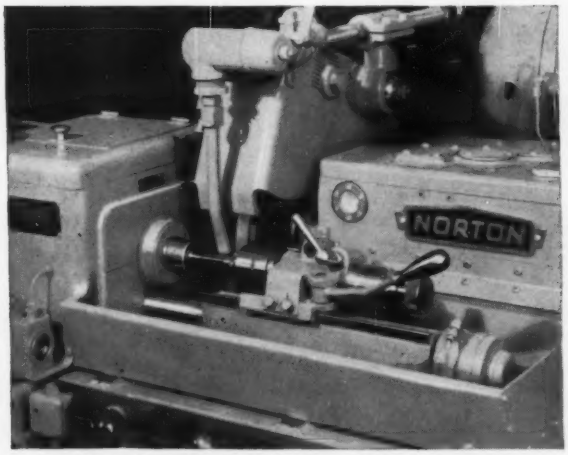

Norton CAM-O-UNIT* Mechanisms, made in varying work capacities, are particularly valuable for extending the proved advantages of Norton CTU cylindrical grinders to the grinding of cams, elliptical pistons and many other forms. The CAM-O-UNIT mechanism shown is attached to a 6″ CTU to grind the three faces of a carbide tool bit.

If you're producing, or planning to produce, components in shapes you consider difficult to grind, here's something else worth considering.

Norton CAM-O-MATIC grinders, piston grinders and CAM-O-UNIT mechanisms are engineered to handle a wide range of cam and shape grinding . . . including endless variations of square, triangular, oval and many-sided forms . . . and to provide the exact forms and tolerances you need with fast, trouble-free performance that will lower your operating costs.

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STEELWELD Mechanical Press Brakes Catalog No. 2023

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MECHANICAL and

Each Line Quality Built

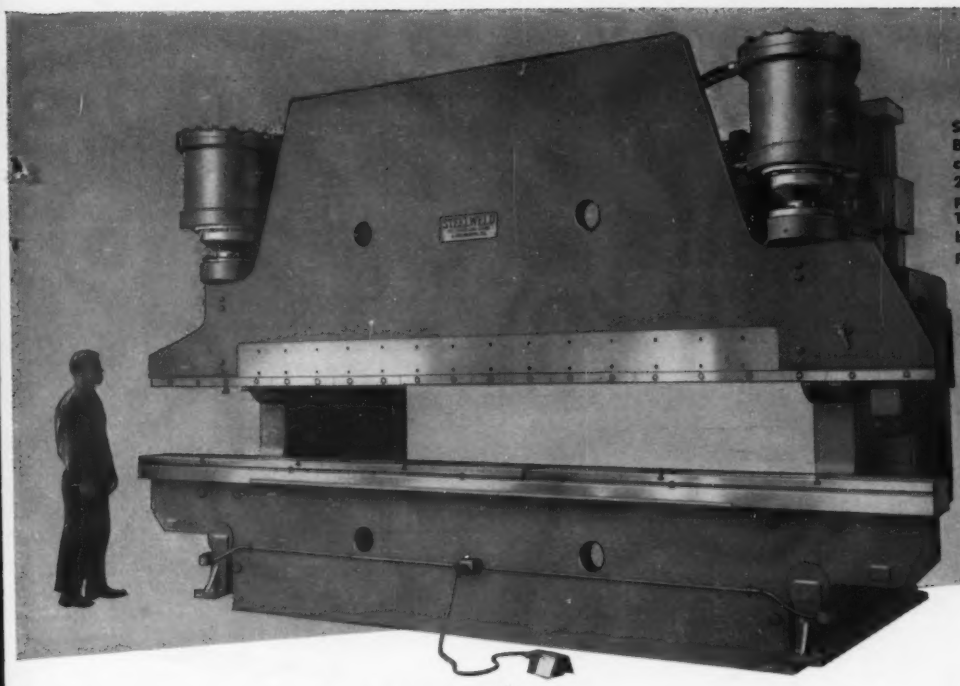
The smooth operation of Steelweld Mechanical Shears with exclusive pivoted-blade has proven a tremendous advantage to a great list of users. This shear is rated 10'-0" x ¼". Others available for plate to 30 ft. and thicknesses to 2 inches.

STEELWELD Mechanical Pivoted-Blade Shears Catalog No. 2011

For Nearly 30 Years STEELWELD Has Been a Leading Name in Metalworking Machinery.

These FREE catalogs give you complete details.

Write or phone for catalogs desired, and we will rush them to you.



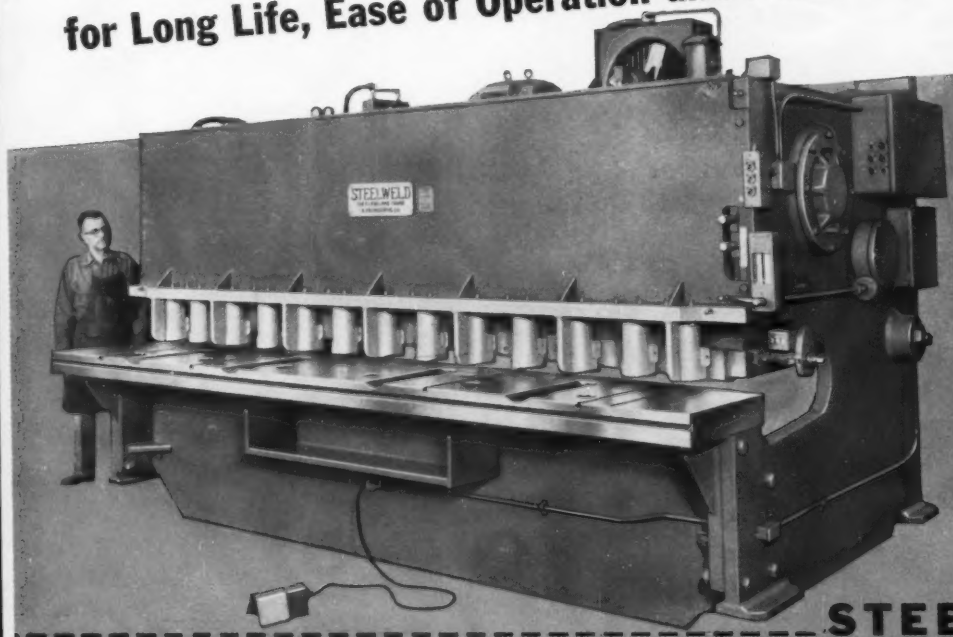
Steelweld Hydraulic Press Brakes are available in capacities from 200 to 2000 tons for working plate in lengths to 30 feet. The picture is of a 500 ton brake that will form steel plate up to 20' x 5/16".

STEELWELD Hydraulic Press Brakes
Catalog No. 2024

Offers Complete Lines of

HYDRAULIC PRESS BRAKES and SHEARS

for Long Life, Ease of Operation and Finest Performance



Steelweld Hydraulic Shears have two remarkable features not available on any competitive machine: Single-cylinder drive and pivoted-blade cutting action. The shear shown here handles plate to 12' x ½". Other sizes go to 30 feet and for plate thicknesses to 2 inches.

STEELWELD Hydraulic Pivoted-Blade Shears
Catalog No. 2030

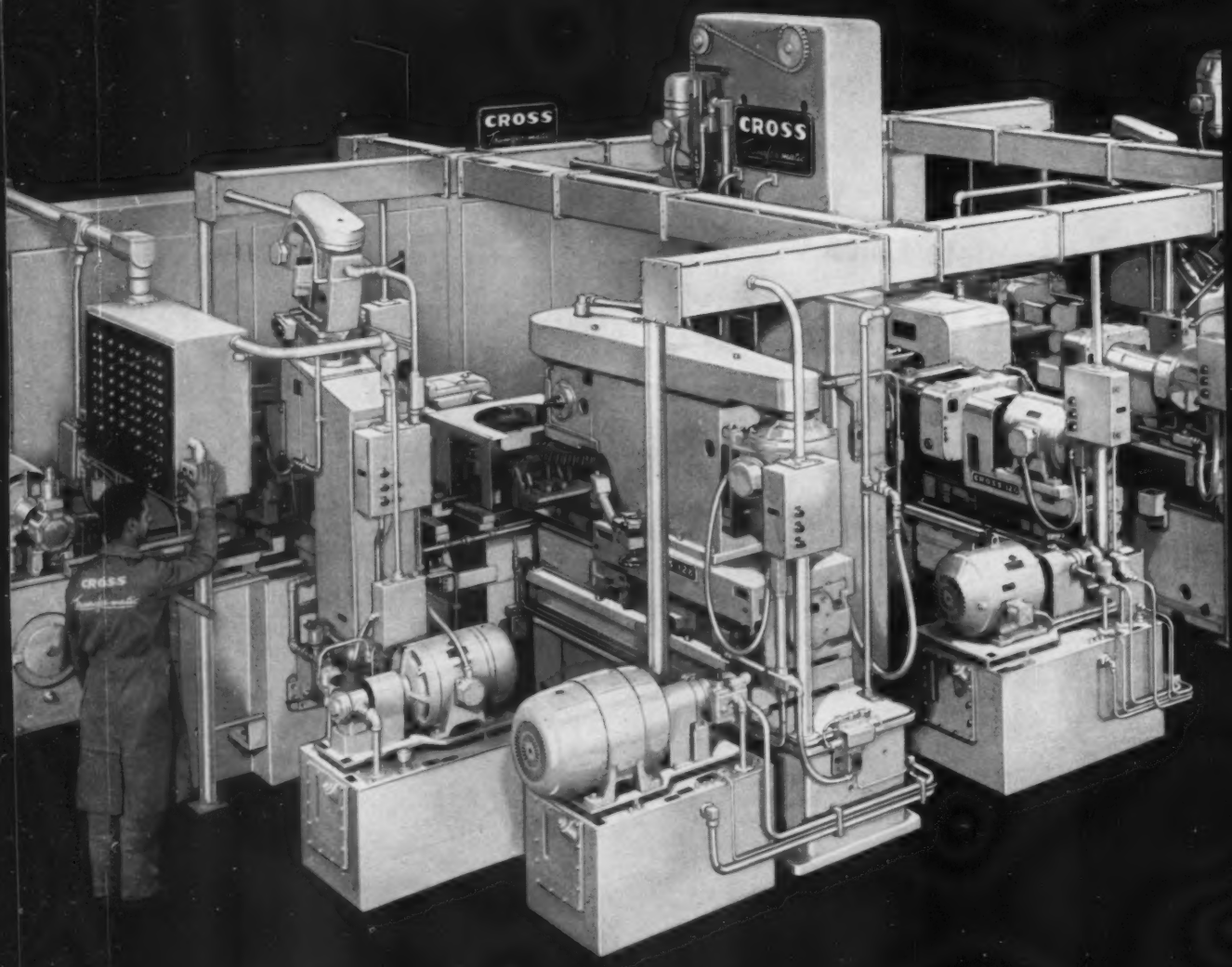
STEELWELD
Mechanical and Hydraulic BRAKES and SHEARS

STEELWELD MACHINERY DIVISION
The Cleveland Crane & Engineering Co.
5478 East 281st St., Wickliffe, Ohio

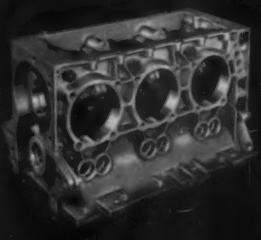
STEELWELD Machinery also includes One-, Two- and Four-Point Straight-Side Presses and Speed-Draw Presses.

For more data, circle this page number on inquiry card

New Cross Transfer-matic Developments Reduce Machine Down Time Problems

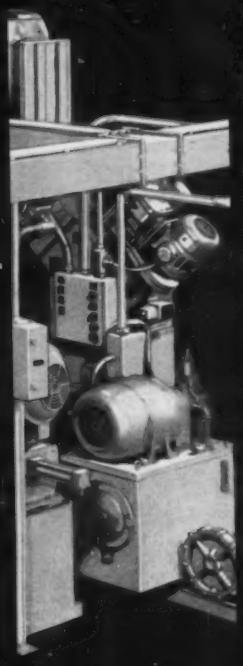


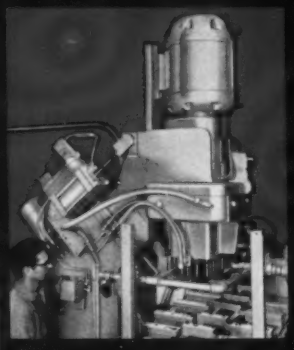
PART: Crankcase assembly.
OUTPUT: 128 pieces @ 100%.
OPERATIONS: Milling, drilling, reaming and tapping.



The cutter changing mechanism overcomes problems usually encountered where heavy, large diameter milling cutters are mounted on vertical spindles.

The head is a standardized Cross adjustable spindle "building block" unit for heavy duty production milling.





As shown above, the "swivel head" is in operating position. For changing tools, the head is "swiveled" by a manually controlled hydraulic cylinder as shown below.

More Automation Progress by Cross

Innovations For Greater Accessibility, Faster, Easier Tool Changing and Electrical Trouble Shooting

Several new design developments in this Cross Transfer-matic for machining 6-cylinder, aluminum crankcase assemblies contribute significantly to reduced predictable and unpredictable machine down time for tool change and electrical trouble shooting.

LESS PREDICTABLE DOWN TIME: A cutter changing mechanism on the milling head at Station 4 handles the cutter for the tool set-up man, speeds up cutter replacement, prevents blade chipping and promotes safety.

In the final station of the machine, a new "swivel mounting" arrangement is employed on a 19 spindle tap head. For changing tools, the head is swiveled out of the work area thus providing maximum accessibility for easier, fast tool changes.

LESS UNPREDICTABLE DOWN TIME: Electrical trouble shooting on this machine is greatly simplified by another new Cross development—integral machine unit push button-terminal stations. All terminal wiring formerly located in the wing base has been combined in the push button panel. By removal of all wiring from inside the wing bases, unpredictable electrical failure from exposure to coolants and moisture in the base is prevented and accessibility minimizes downtime for trouble shooting.

To prevent scratching and scuffing of the locating surfaces of this aluminum part, a lift and carry mechanism is employed.

Cross "building block" construction permits economical conversion as part design changes occur.

In your next tooling job, make Cross Transfer-matics your first choice for production milling, drilling and boring operations.

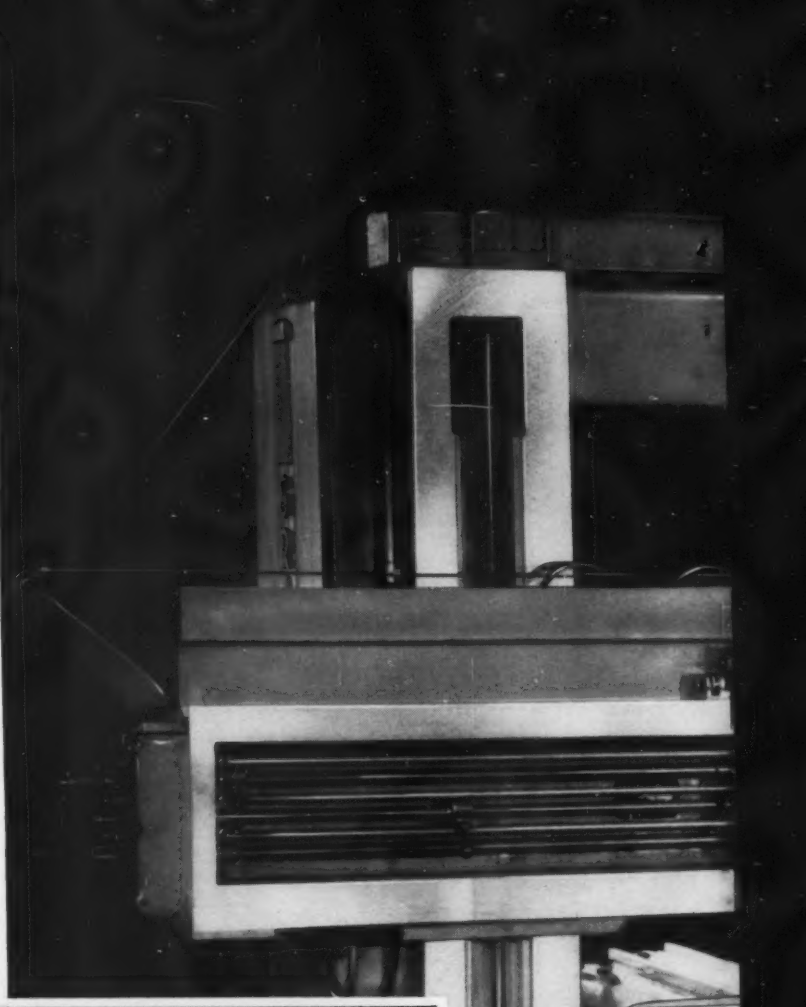
Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

For more data, circle this page number on inquiry card



heavy-duty planing

The Gray Universal is the world's most powerful planer available for conventional planing. Its rigidity and speed are ideally suited for modern carbide cutting.

double-cutting

The flick of a lever, the touch of a button permits double-cutting. Elimination of the idle stroke insures the world's most efficient flat surface machining. Only simple carbide tools are required.

triple-cutting

Rough and rough-finish plane at the same time. Rough by double-cut planing and simultaneously rough-finish with a single point tool. Then finish plane without a tool change.

cross planing

Eliminates extra settings by cross planing the occasional keyways, chamfered corners, and other troublesome small cross surfaces that formerly added hours to your set-up time.

a GRAY

the only

This new 84" x 60" x 18' Gray Universal Planer shown in operation at the Koppers Co., cuts going - cuts coming, removes big chips at double rate. There is no idle return stroke to waste precious production hours. Instantaneous reversals with heavy duty double-cutting make this the first REAL new development in modern planers ***...a GRAY exclusive.***

Double tables further virtually eliminate the costly set-up time required by ordinary planers.

The multiple savings received by users of the new Gray Universal make it a wise investment.

If it's new... it must be a GRAY.

The G. A. GRAY Co.,
Cincinnati, Ohio

GRAY Universal Planer shown in operation at the Baltimore plant of Koppers Company, Inc., Metal Products Division.

new planer

why make parts the slow, costly way?

COLD-HEAD THEM!

Steel

Tappet plunger, splined square-head shaft, collar for adjustment wedge, universal joint bearing cup, pipe plug, spark plug body.

Copper

Ornamental stud, distributor cap center insert, commutator bar, wire clamp, solenoid contact, starter field terminal.

Aluminum

Hollow rivet, blind rivet, flanged collar, link, distributor cap outside insert.

Precious Metals

Electrical contact, transistor case, miscellaneous rivets and electrical contacts.

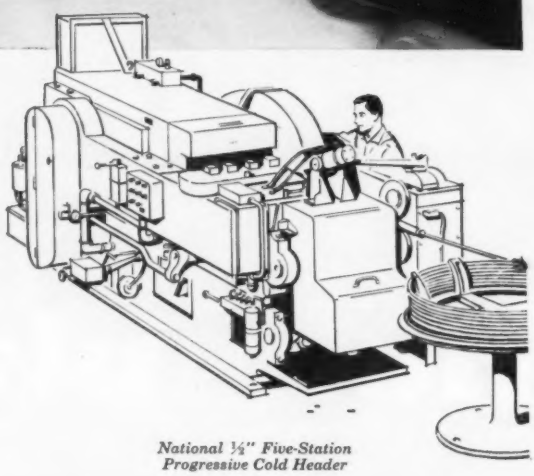
Of various metals, the parts identified above were developed for fast, accurate production on National Cold Headers.

Most of these important jobs are made without waste, ready for end use. All are cold-forged from coiled wire – start-to-finish in one compact Header – without any intermediate steps.

New technical break-throughs are making jobs like the above every day commercial realities. More workable wire, better lubricants, improved die materials and vast engineering experience are combining to adapt formerly difficult work to modern, profitable methods.

Whether you now have Headers or not, send us prints or samples of your jobs, or bring them to Tiffin where more of our people can help with *your* problem.

Perhaps up-to-date Cold Heading, a truly fast-growing process in metalworking, can pay off for you.



National ½" Five-Station Progressive Cold Header

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

HARTFORD DETROIT CHICAGO

Sides of compressor valve plates ground parallel to .0003" tolerance at 240 per hour

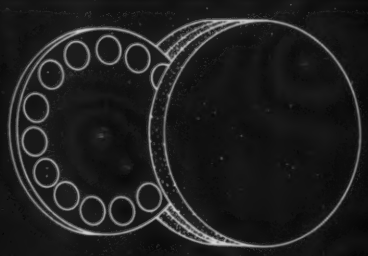
New Gardner 2H40-42" Precision Disc Grinder

surface grinds TWO sides parallel in ONE operation

For complete facts on the new 2H40, write today for latest catalog. Or send prints of your parts for a Gardner proposal.

production data

Operation	Grinding two parallel sides of valve plates
Material	SAE 1440 steel
Size	5.300" x .170"
Rate	240 per hour
Stock Removal	.004"-.006" max. overall
Flatness	.0003"
Parallelism	.0003"
Uniformity	.002"
Finish	12 RMS



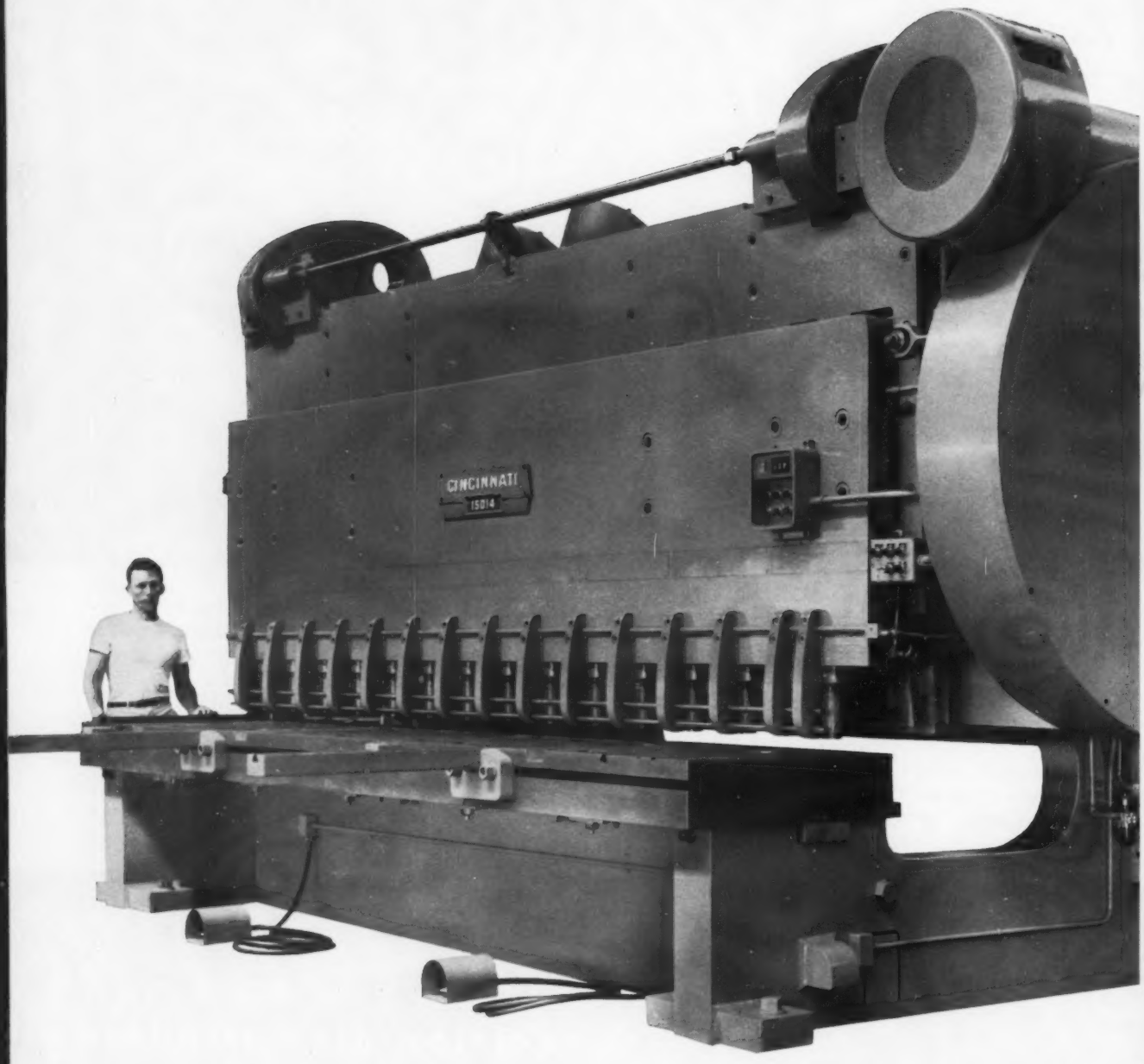
GARDNER

precision disc grinders

BELOIT, WISCONSIN

This CINCINNATI®...

1¼ in. thick X



shears mild steel plate

14 ft. long

This 15014 Series Cincinnati All-Steel Shear has a 36″ gap and a 48″ back gage range.

Power for heavy cutting with accuracy and operating convenience are combined in this machine.

Modern features such as — Hydraulic Holddowns, Front Operated Power Back Gage, Hinged Back Gage Angle, Automatic Pressure Lubrication, All-Steel Interlocked Construction, Forged Alloy Steel Eccentric Shaft—all contribute to an outstanding performance with low maintenance and high accuracy.

See your Cincinnati Representative for either Heavy or Light Shearing Applications. Write for Catalog S-7R.

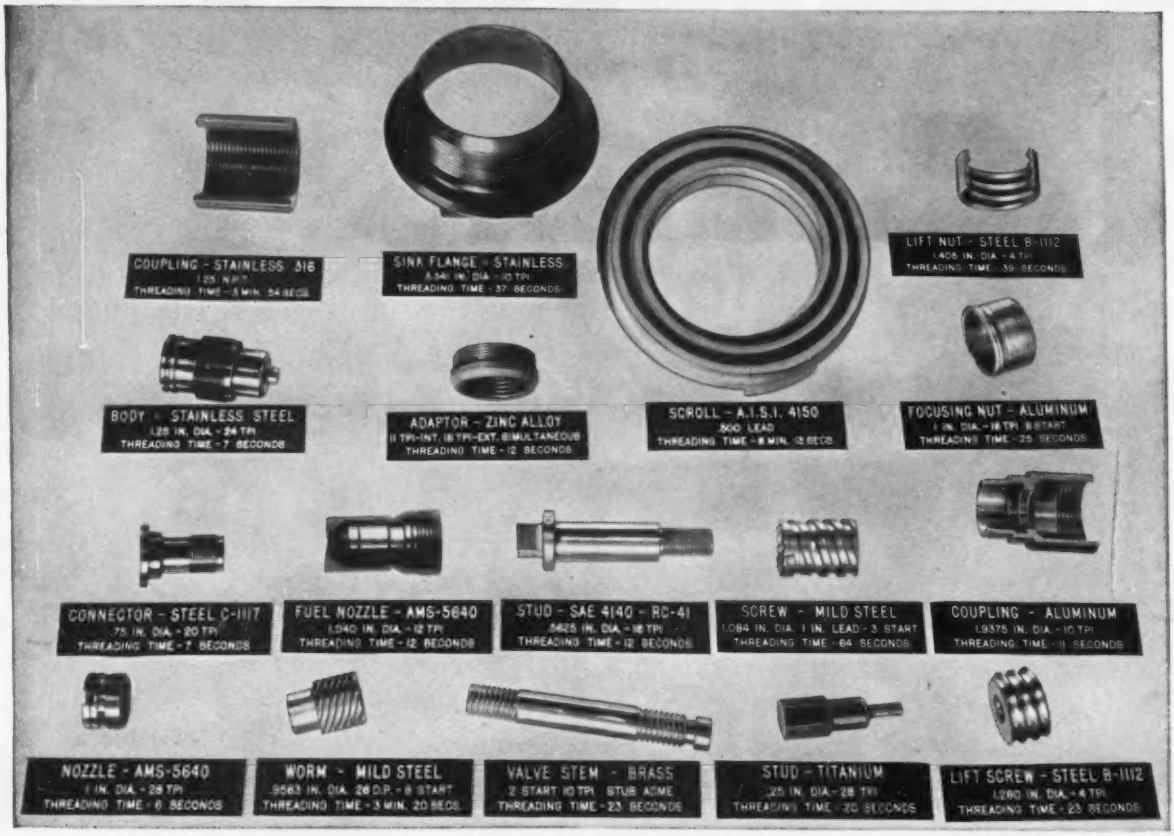
Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.

For more data, circle this page number on inquiry card

Start saving money right now on threading jobs like these with...


COUPLING - STAINLESS 316
1.05 N.P.T.
THREADING TIME - 5 MIN. 54 SECS.
SINK FLANGE - STAINLESS
THREADING TIME - 37 SECONDS
LIFT NUT - STEEL B-1112
1.405 IN. DIA. - 4 TPI
THREADING TIME - 39 SECONDS
BODY - STAINLESS STEEL
1.25 IN. DIA. - 24 TPI
THREADING TIME - 7 SECONDS
ADAPTOR - ZINC ALLOY
11 TPI-INT. 18 TPI-EXT. SIMULTANEOUS
THREADING TIME - 12 SECONDS
SCROLL - A.I.S.I. 4150
500 LEAD
THREADING TIME - 8 MIN. 12 SECS.
FOCUSING NUT - ALUMINUM
1 IN. DIA. - 18 TPI 8 START
THREADING TIME - 25 SECONDS
CONNECTOR - STEEL C-1117
.75 IN. DIA. - 20 TPI
THREADING TIME - 7 SECONDS
FUEL NOZZLE - AMS-5640
1.040 IN. DIA. - 12 TPI
THREADING TIME - 12 SECONDS
STUD - SAE 4140 - RC-41
.5625 IN. DIA. - 18 TPI
THREADING TIME - 12 SECONDS
SCREW - MILD STEEL
1.084 IN. DIA. 1 IN. LEAD - 3 START
THREADING TIME - 64 SECONDS
COUPLING - ALUMINUM
1.9375 IN. DIA. - 10 TPI
THREADING TIME - 11 SECONDS
NOZZLE - AMS-5640
1 IN. DIA. - 28 TPI
THREADING TIME - 6 SECONDS
WORM - MILD STEEL
.9583 IN. DIA. 26 D.P. - 8 START
THREADING TIME - 3 MIN. 20 SECS.
VALVE STEM - BRASS
2 START 10 TPI STUB ACME
THREADING TIME - 23 SECONDS
STUD - TITANIUM
.25 IN. DIA. - 28 TPI
THREADING TIME - 20 SECONDS
LIFT SCREW - STEEL B-1112
1.280 IN. DIA. - 4 TPI
THREADING TIME - 23 SECONDS

CRI-DAN SINGLE-POINT THREADING LATHES

...cut costs with simple single-point carbide tools. They're easily resharpened or replaced. They eliminate expensive upkeep of thread milling cutters or thread grinding wheels.

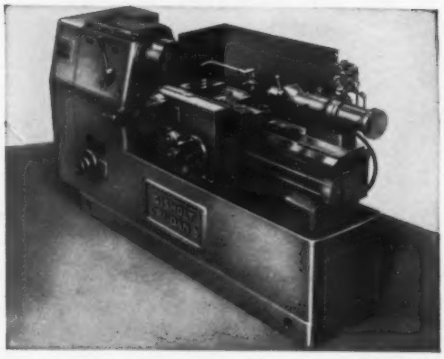
...assure extremely accurate lead and thread form and exceptional finish with low-cost carbide tools on materials that don't allow economical threading by other methods.

...handle any material from titanium or toughest alloy steels to brass and other non-ferrous metals with a wide selection of spindle speeds and feeds to meet all job requirements.

...set up fast to produce single- or multiple-start, coarse or fine, left- or right-hand threads, parallel or tapered with metric or inch pitches—thread up to shoulders on all types of internal and external operations.

...cut costs from start to finish with CRI-DAN's speed, versatility and economy.

Why put off the savings the CRI-DAN method can bring you *right now*? Ask your Gisholt Representative for complete details. Or write us for literature or cost estimates on your particular work.



Two models are available. The smaller Model B (shown) offers extreme flexibility with spindle speeds of from 154 to 2808 r.p.m.; 3' capacity between centers and 15½" swing over bed. Rugged saddle supports fast-acting threading slide, easily positioned along bed. Complete change-over from job to job can be made in 15 minutes.

Investigate Gisholt's Extended Payment and Leasing Plans

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • *Factory-Rebuilt Machines with New-Machine Guarantee*

Gardner solves problem of grinding unequal areas with two disc specifications

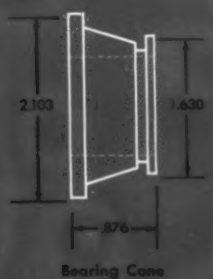
discs with different bonds and structure permit high production grinding to desired tolerances

Gardner BGR disc specification

- wider grain spacing
- deep grain penetration
- effective chip clearance

Gardner BKGR disc specification

- fast stock removal
- cool cutting
- effective chip clearance

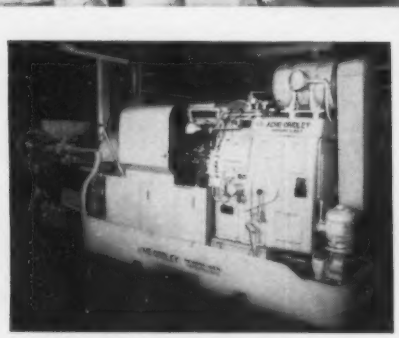


Call the Gardner Abrasives Specialist for practical solutions to your disc grinding problems.

GARDNER

abrasive discs

BELOIT, WISCONSIN



1⅛"-RB6 Acme-Gridley producing 266 thermometer sockets per hour at Manning, Maxwell & Moore, Inc., Stratford, Connecticut, manufacturers of industrial thermometers and gauges.

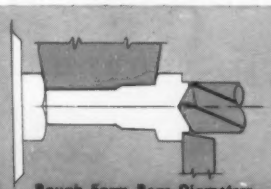
Close-up of tooling zone showing 4th and 5th position operations.

Spindle-for-Spindle

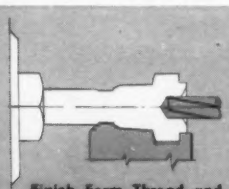
PRODUCTION INCREASED OVER 200%

for Manning, Maxwell & Moore, Inc.

12 Operations in 22 Seconds



6. Rough Form Rear Diameters —Spot Drill—Turn Front Diameter



1. Finish Form Thread and Front Diameter—Drill ⅜" Diameter

NATIONAL ACME'S "ZONE OF RESPONSIBILITY" INCLUDES ALL PHASES OF COST REDUCTION

Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by Manning, Maxwell & Moore, Inc. . . . an "every day" job for Acme-Gridleys.

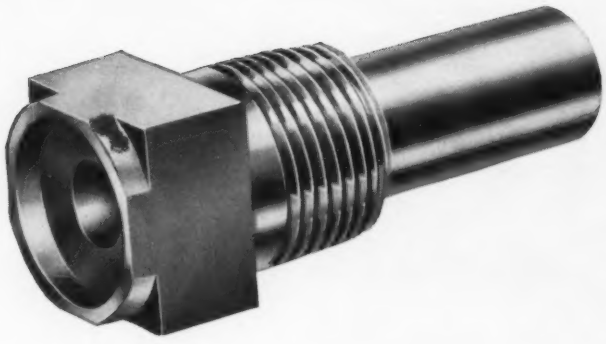
Indirect Costs: effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc.

Product Redesign: teaming with your design group to take full advantage of Acme-Gridleys' cost reducing capabilities.

Direct Material Costs: our engineers provide important savings in this area by constantly matching machines and tools to modern metallurgical problems.

Make-or-Buy Reviews: in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment.

Spot Modernization: pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.

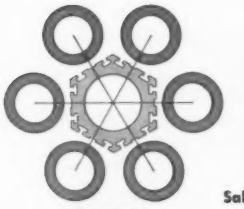


"*Cost-per-piece is substantially reduced* . . . and our increased production has enabled us to keep ahead of competition," says this manufacturer of precision industrial thermometers, gauges and valves.

"Former automatics could not keep pace with production requirements . . . many parts had to be 'farmed out', thus increasing our costs. In addition, the only downtime has been the short periods necessary for tool grinding. What's more . . . a secondary operation for deep-hole drilling was completely eliminated!"

Further benefits were realized with Acme-Gridleys' quick-change, quick-setting toolholders and wide-open tooling zones which enabled Manning, Maxwell & Moore to produce two other parts on the same machine...with only minor changes in the set-up. Add to this the extreme accuracy and flexibility of direct camming and independently operated toolslides, and you will realize why this manufacturer found his Acme-Gridleys a profitable investment.

It will pay *you* to investigate the complete story on the industry's more modern approach to cost reduction. Call, write or wire.

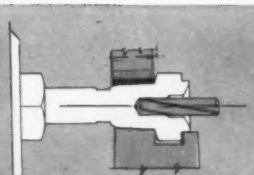


Pioneer in Circumferential Automation

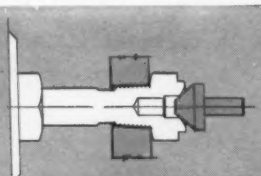
National Acme

THE NATIONAL ACME COMPANY
179 E. 131st STREET
CLEVELAND 8, OHIO

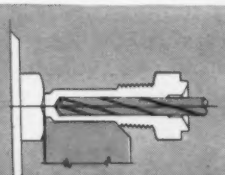
Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.



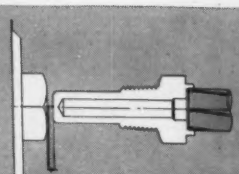
2. Shave Thread and Front Diameter—Drill 5/16" diameter partway



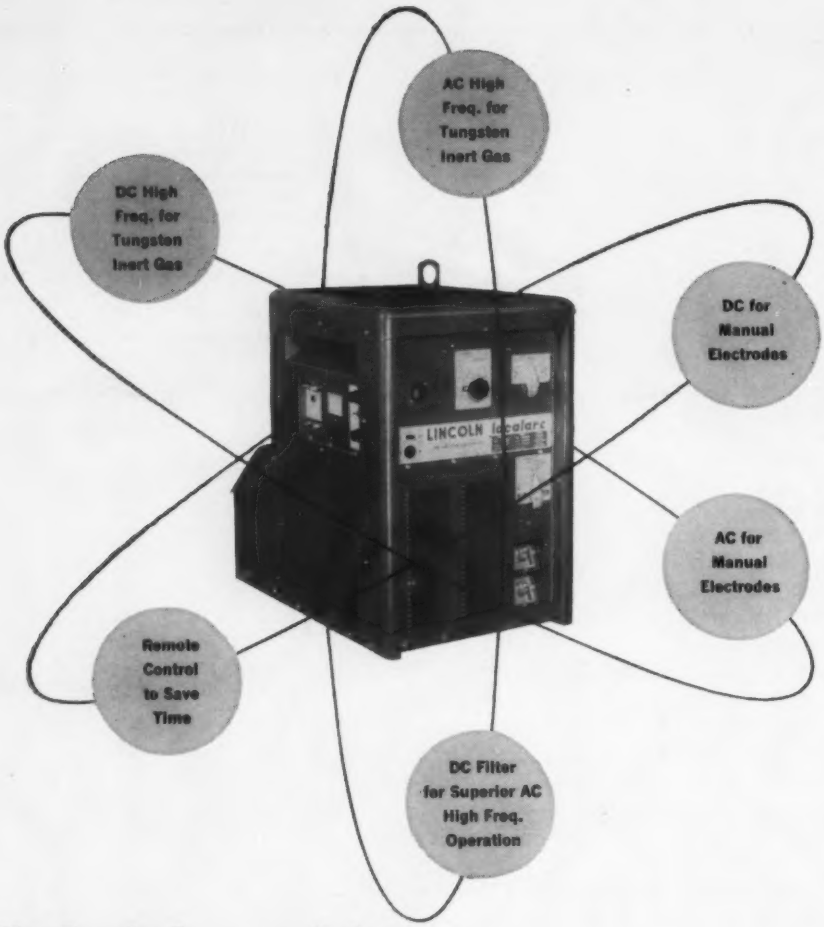
3. Roll Thread—Support



4. Finish Form Rear and Break-down for Cutoff—Drill 5/16" diameter remainder



5. Counterbore Large Diameter—Cutoff


AC High Freq. for Tungsten Inert Gas
DC High Freq. for Tungsten Inert Gas
DC for Manual Electrodes
AC for Manual Electrodes
Remote Control to Save Time
DC Filter for Superior AC High Freq. Operation
LINCOLN Idealarc

Weld little jobs or big . . . use inert gas or stick electrode . . . on AC or DC welding current, with "IDEALARC TIG"

At last, here is a welder which gives complete versatility to maintenance-welding departments or to job shop operations. The "Idealarc TIG", equipped with high-frequency and water and gas controls can be used for welding stainless or aluminum. With just a flick of a switch, the same machine can do production welding with AC stick electrodes or pipe welding on DC.

But, if your operation does not require complete versatility, you can still have the superior welding qualities of the "Idealarc TIG" without all the optional extras. That's because Lincoln lets you select (and pay for), just the features you need.

The NEMA-rated "TIG" model has welding current ranges of 10-450 amps on AC and 10-375 amps on DC. For complete information, write to us for Bulletin 4608.1.

Price:

$1041 *(in Zone 1)*

COMPLETE WITH:

- AC and DC Current Selection
- High Frequency
- Gas and Water Controls
- Balanced Wave Filter
- Power Factor Correction
- Remote Current Control

LINCOLN ...USA

THE LINCOLN ELECTRIC COMPANY

Dept. 1237, Cleveland 17, Ohio

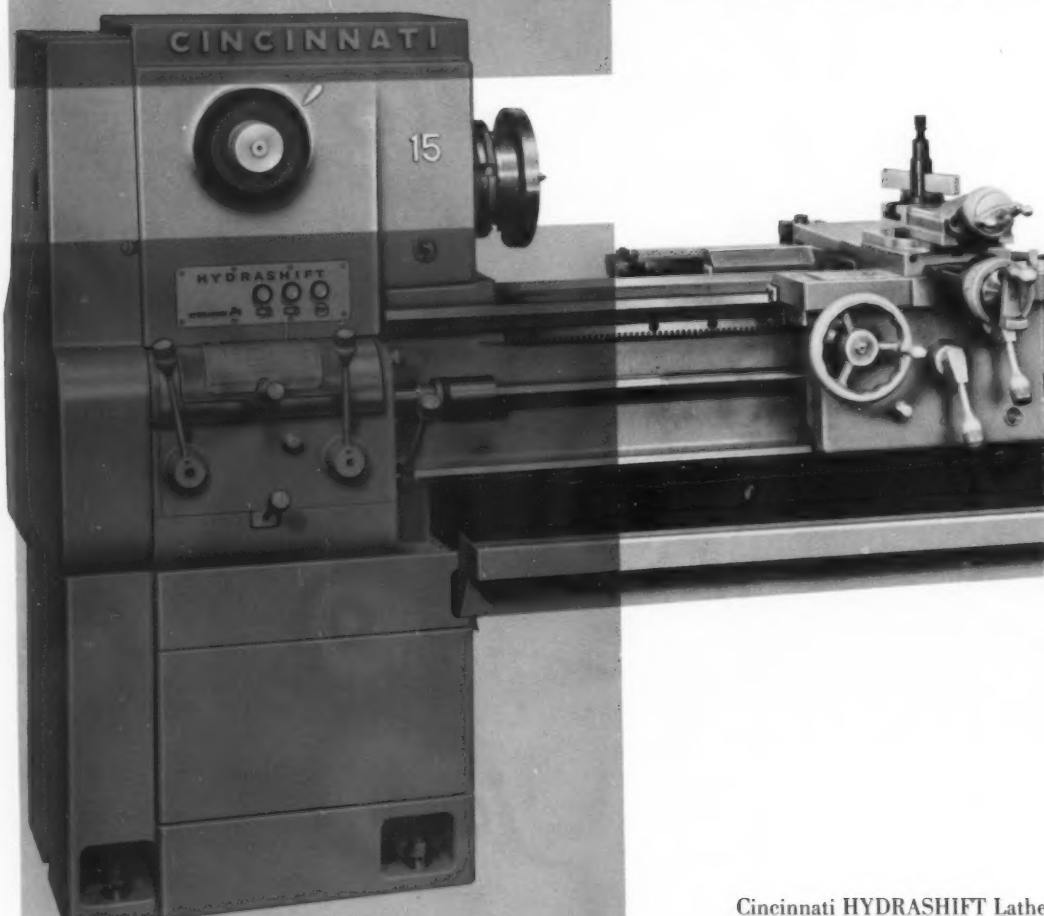
The world's leading manufacturer of arc welders and electrodes, ac motors and battery chargers.

hydraulic power supplies

new

cincinnati hyd

hydrashift, the easiest
geared head lathe, cuts machine
work. To change spindle speeds,
hydraulic power does the shifting.



Cincinnati HYDRASHIFT Lathe
18″ swing sizes, and a wide var
sizes may be equipped with C
for even greater productivity.

Ask your CL&T Dealer today
from CINCINNATI, or write to

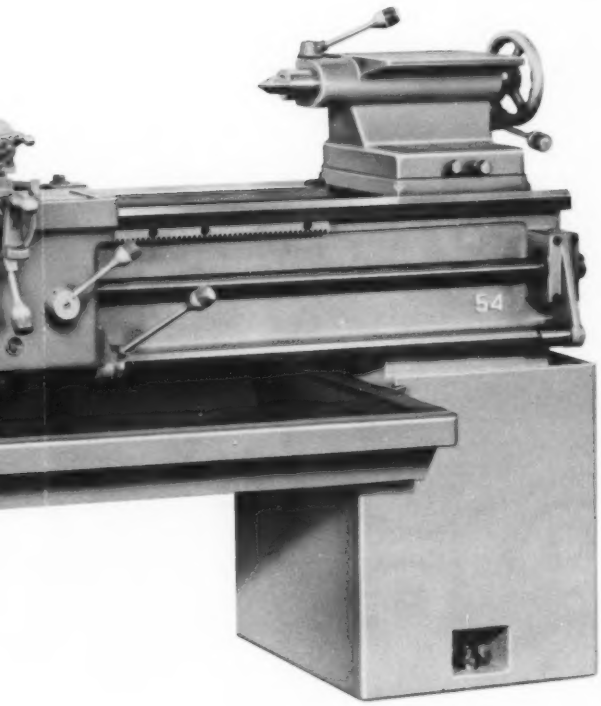
cincinnati lathe and tool co.

"HYDRASHIFT" Lathes

es the muscle on

ydrashift

siest and fastest method for spindle speed shifting on a
hine handling time . . . lets the operator produce more
eeds, the operator has only to dial the desired RPM . . .
ng.



Lathes are built in 10″, 12½″, 15″ and
e variety of bed lengths. 15″ and 18″
th Cincinnati HYDRAGUIDE tracers
ty.

day about this exciting new development
e to us direct.

These CINCINNATI LATHES are NEW—from headstock to tailstock! They are designed to provide more time for cutting and to reduce operator fatigue to a minimum. Yet, with their many new operating features, they are still economy priced.

new High Speeds with All-Geared Headstock—husky, Hydrashift gearing provides 12 speeds in geometric progression up to 3000 RPM.

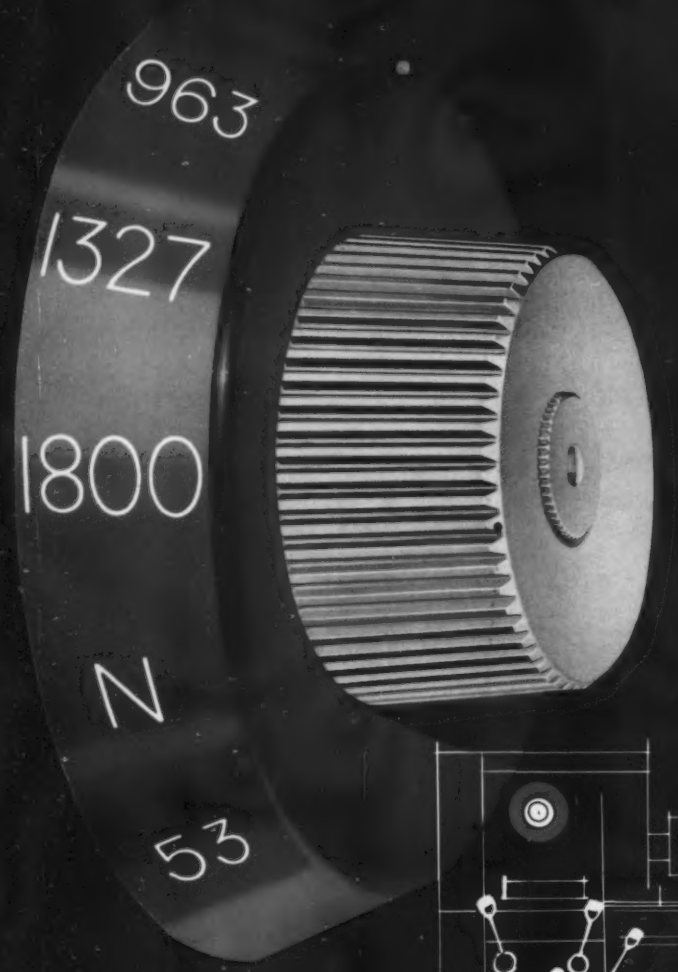
new Compound and Cross Slide—wider, heavier bridge, compound and cross slide for heavy, high-speed cuts; large, easy-reading dials for new accuracies with greater operator speed and convenience.

new Quick-Clamping Tailstock—Cincinnati's unique tailstock design is even more versatile for fast tailstock positioning.

plus **new** greater horsepower . . . NEW husky beds with "Hardclad" flame-hardened ways . . . NEW coded push-button controls . . . NEW chip pan (slides in and out for convenient cleaning) . . . Totally enclosed quick-change feed box with 48 threads and feeds . . . and many other exclusive features on the NEW CINCINNATI HYDRASHIFT LATHES.

O. 3207 disney street, cincinnati 9, ohio

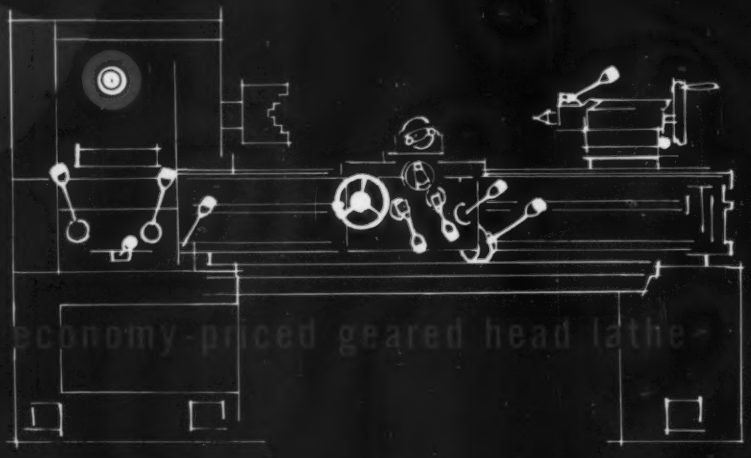
nes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners



new

new

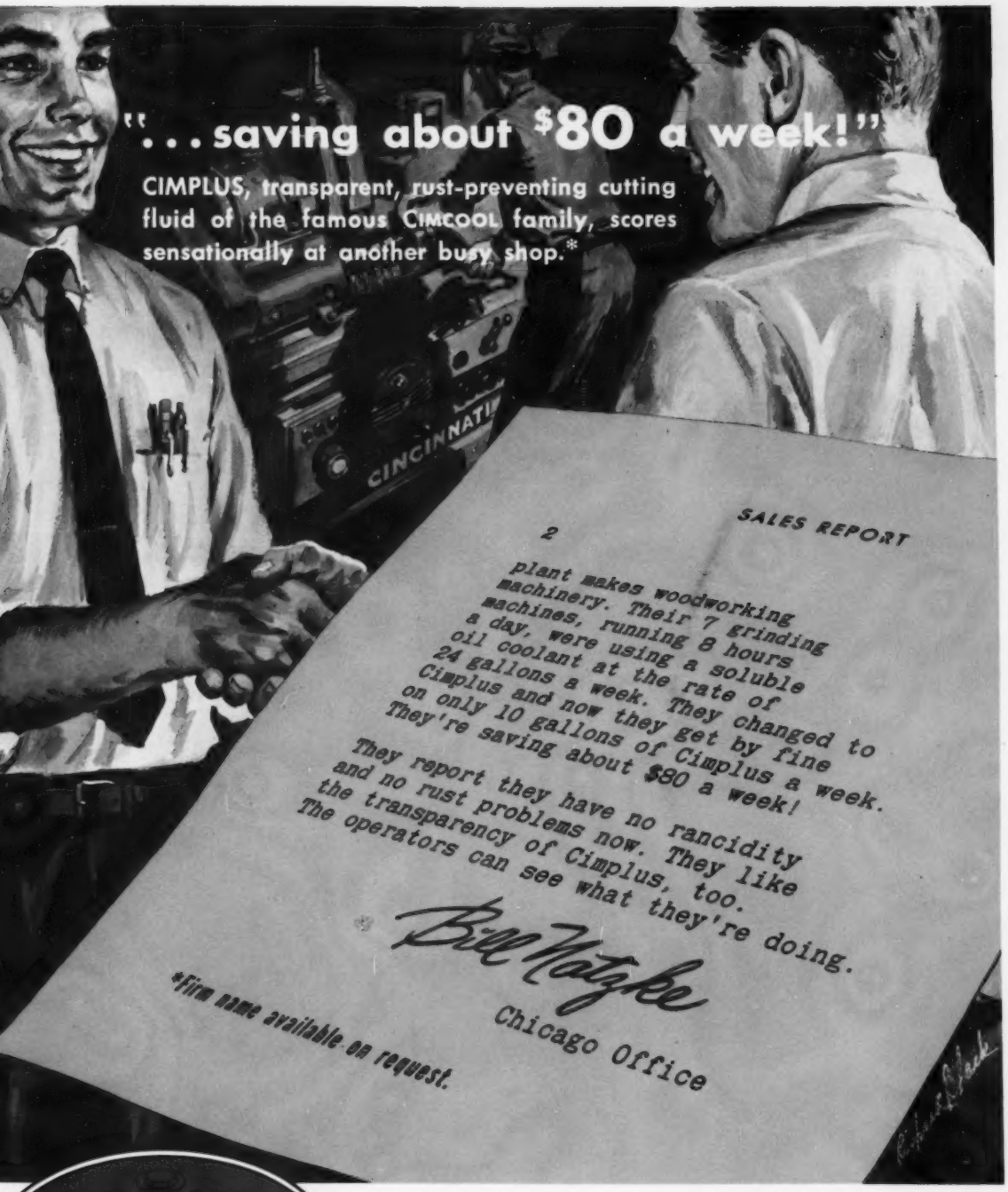
from cincinnati
lathe and tool....

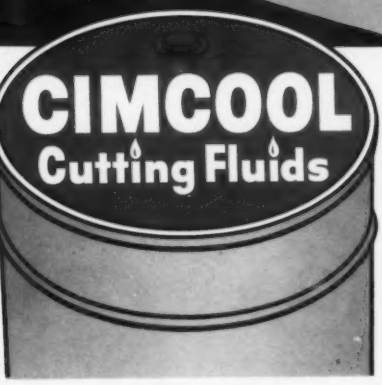


the first economy-priced geared head lathe

with power dial speed shifting

cincinnati hydrashift


"...saving about $80 a week!"
CIMPLUS, transparent, rust-preventing cutting fluid of the famous CIMCOOL family, scores sensationally at another busy shop.*
CINCINNATI
2
SALES REPORT
plant makes woodworking machinery. Their 7 grinding machines, running 8 hours a day, were using a soluble oil coolant at the rate of 24 gallons a week. They changed to Cimplus and now they get by fine on only 10 gallons of Cimplus a week. They're saving about $80 a week!
They report they have no rancidity and no rust problems now. They like the transparency of Cimplus, too. The operators can see what they're doing.
Bill Matzke
Chicago Office
*Firm name available on request.



FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL S2 Concentrate—The pink fluid which covers 85% of all metal cutting jobs.
CIMPERIAL—newest in the famous, industry-proven line of CIMCOOL® Cutting Fluids!
CIMPLUS—The transparent grinding fluid which provides exceptional rust control.
CIMCUT Concentrates (AA, NC, SS)—For every job requiring an oil-base cutting fluid.
ALSO—CIMCOOL Tapping Compound—CIMCOOL Bactericide—CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

®Trade Mark Reg. U.S. Pat. Off.

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LOGAN HAS IT!

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TOP QUALITY

PEAK PERFORMANCE

in hydraulic power devices

LOGANSPORT MACHINE CO., INC.
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- ☐ 100-1 AIR CYLINDERS
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- ☐ 100-6 ULTRAMATION CYLINDERS
- ☐ 300-2 PRESSES
- ☐ FACTS OF LIFE
- ☐ 200-1 HYD. POWER UNITS
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COMPANY _____

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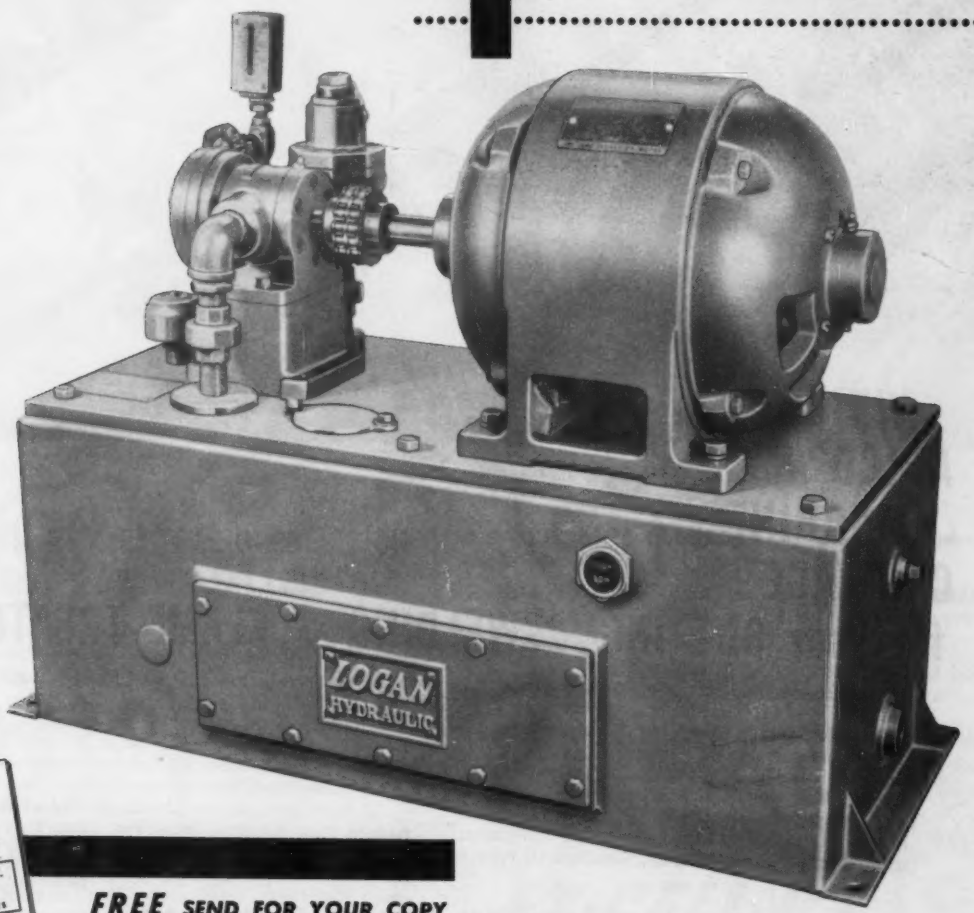
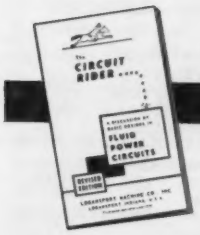


ILLUSTRATED—LOGAN MODEL 6031 HYDRAULIC POWER UNIT



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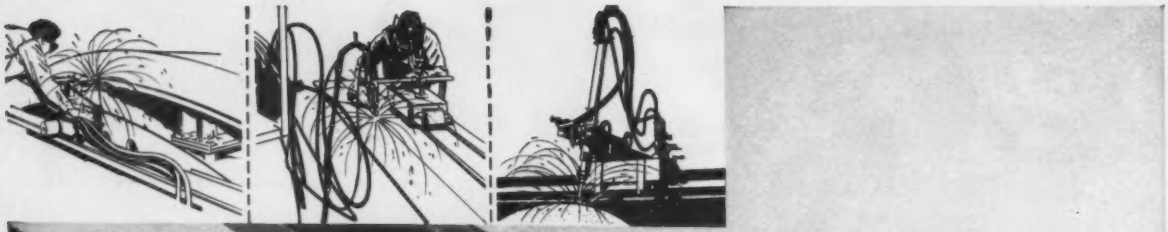
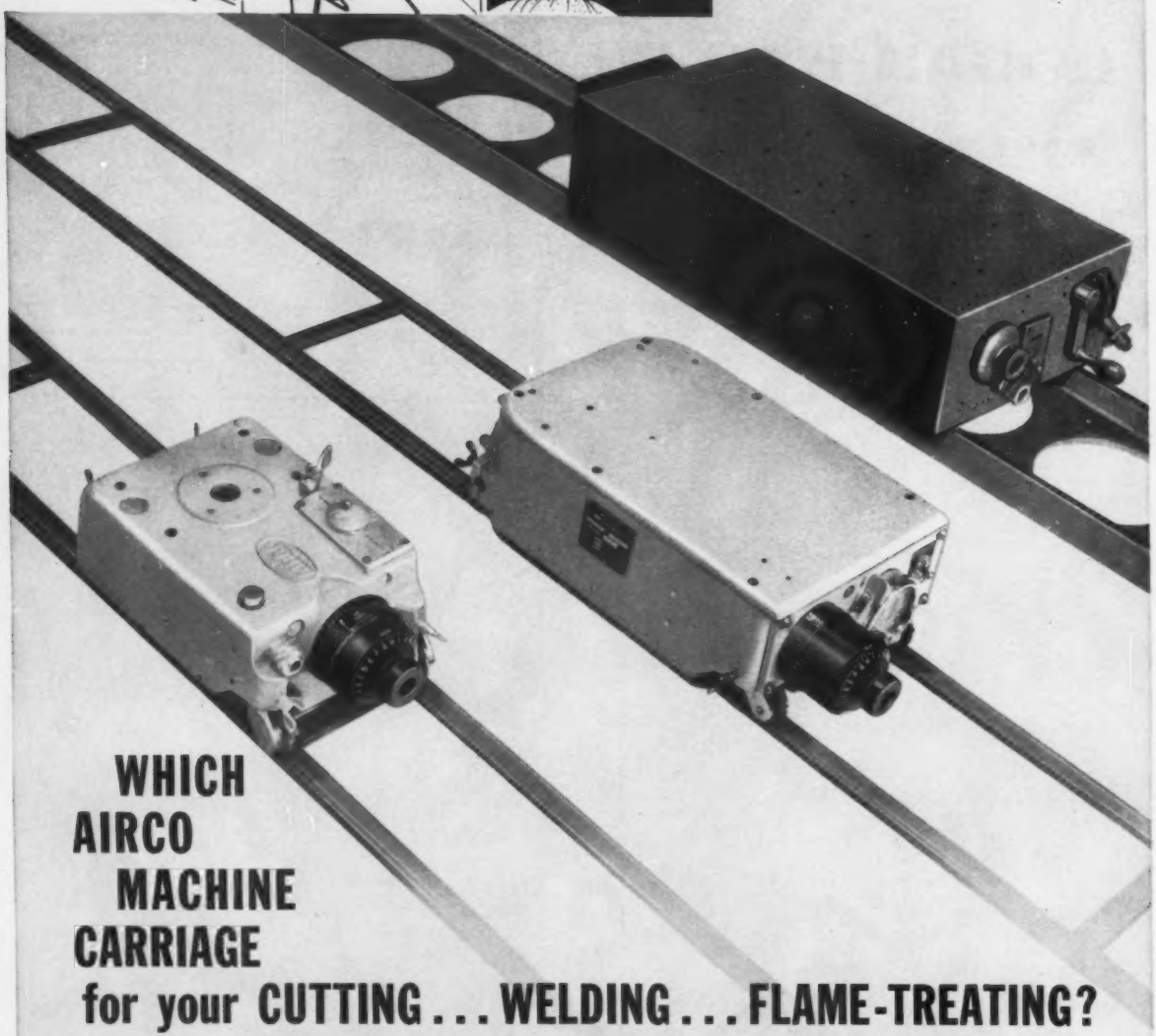
A 32-page manual on fluid power circuits (fifth edition) completely revised to present current engineering trends.

MEMBERS: Natl. Mach. Tool Builders' Assn.; Natl. Fluid Power Assn.

For more data, circle this page number on inquiry card





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If you use machine carriages you know this: You need the best carriages to do the best work.

For that reason Airco produces these motor-driven and portable Radiagraphs . . . track or contour guided. The No. 41 is designed particularly for the heavyweight jobs; speed range: 1½ to 72 ipm. The No. 20 is a natural for the jobs involving medium-to-heavy cutting and welding equipment; speed range: 2 to 240 ipm. The No. 10 type is built to breeze through the lighter gauge jobs, speed range: 2 to 50 ipm.

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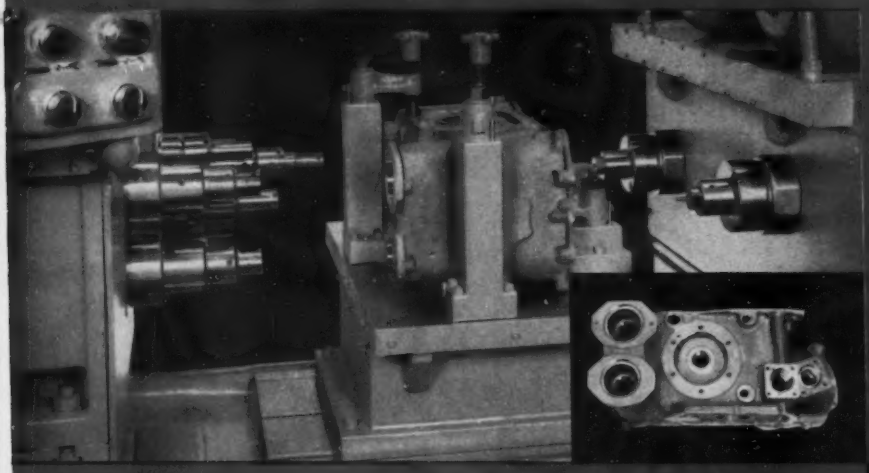
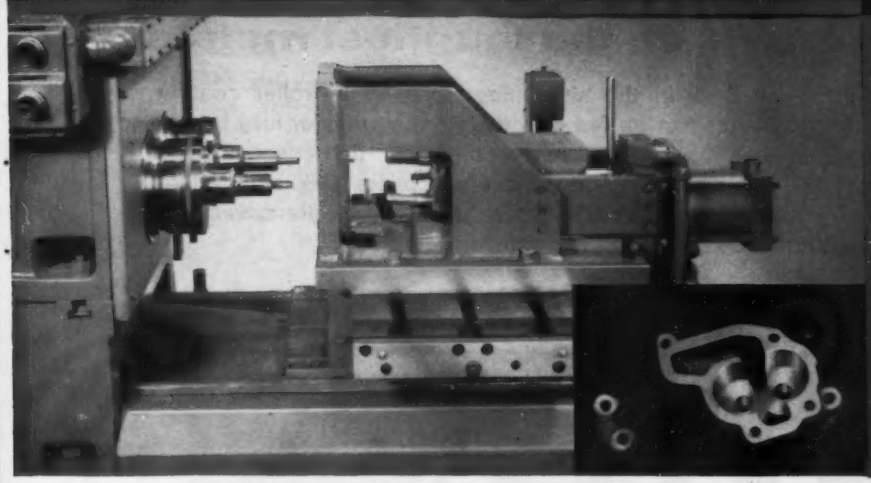
Standard Ex-Cell-O Precision Boring Machines



. . . FOR FASTER MULTIPLE-HOLE WORK

Standard style 17-A performs 26 operations in one cycle on a magnesium aircraft casting. Machine bores five bronze bushings, counterbores seven diameters, faces four surfaces and chamfers eight shoulders with five spindles at left, two spindles at right.



. . . FOR FASTER CLOSE-TOLERANCE WORK

Style 112-D finish-bores gear pockets and shaft holes, and plunge-faces pocket bottoms of oil pump bodies to tolerance of plus or minus .0005". Flat faces are square to the bores and parallel to each other within working limits of .001".

59-17

10 REASONS WHY EX-CELL-O PRECISION BORING MACHINES DO MORE, AT LESS COST!

1. RUGGED—Heavily-ribbed base castings, chatter-free hydraulic-actuated table movement, isolated power assembly.

2. FLEXIBLE—Bridges easily spaced-out for large work, moved in for smaller parts.

3. VERSATILE—Inbuilt versatility, plus Universal Fixtures for toolroom work, short-run and production jobs. Spindles mount in any position.

4. FAST—Rapid table traverse, positive spindle brakes and quick-load fixtures for high output.

5. LOW TOOLING COST—Standard machine components, tools and accessories cut lead time, speed setup.

6. AUTOMATIC LUBRICATION—Separate lubricating system pumps oil directly to the ways.

7. SEALED SPINDLES—Ex-Cell-O Precision Spindles permanently lubricated during assembly.

8. CONVENIENT CONTROLS—Easy to use hydraulic controls contained in a single panel.

9. TROUBLE-FREE—Vital machine parts and controls protected from dirt, chips, coolant. Ready access to components for inspection.

10. CAMS FOR CONTOURING—Cam-operated boring machines available for precision contouring work.

Call your local Ex-Cell-O Representative, or write direct for complete details on the full line of Ex-Cell-O Precision Boring Machines.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

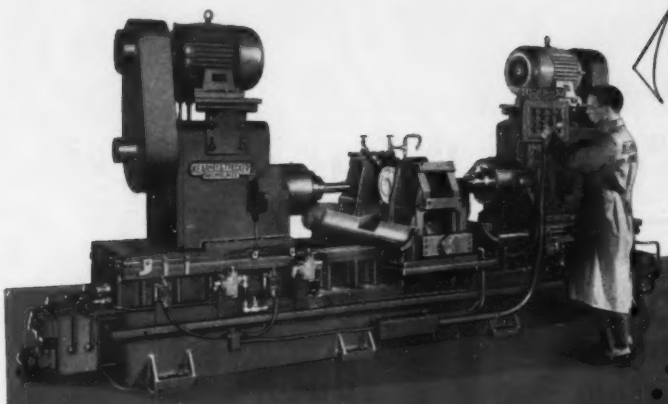
For more data, circle this page number on inquiry card

For the deepest draws on the toughest metals

Johnson's 700 WAX-DRAW does every draw in the shop. *Easy to apply* by roller coating, spraying, dipping, etc. Use wet or dry. Blanks can be fed directly into the press or may be pre-coated, dried and palletized. *Easy to remove,* using solvent bath, vapor degreaser, alkaline washer or even hot water alone. *Money saving.* One gallon undiluted covers 2,000 square feet. Four-to-one dilutions produce excellent results. 700 Wax Draw handles multiple draws with only one application even at pressures to 200,000 p.s.i. and temperatures to 450°F.

For further information write: JOHNSON'S WAX Racine, Wisconsin, Dept. M-11

Another great metalworking product from Johnson's Wax Service Products Division



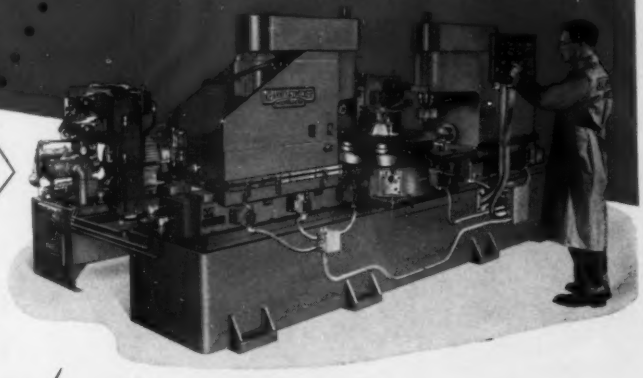
CONSTRUCTION INDUSTRY

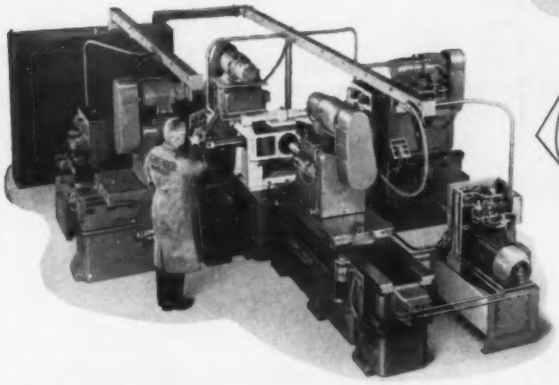
Only one setup is required to rough and finish bore, finish counterbore and face both sides of a tread roller for tractor-type construction equipment. Workpiece is hydraulically clamped . . . seven sizes of rollers can be machined. This method replaces a turret lathe using two setups. New rate is 13 pieces per hour. **Production up — 100%.**

Kearney & Trecker builds PRODUCTION MACHINE TOOLS FOR EVERY INDUSTRY

AIRCRAFT INDUSTRY

Rotary feed, bed-type machine with two opposed vertical spindles mills both sides of aluminum pump body flange to critical thickness and smooth finish *at rate of 76 pieces per hour.* Unit is versatile . . . as many as eight types of pump bodies are milled using only separate fixtures and cams.





ENGINE INDUSTRY

This unit bores four holes in engine block simultaneously . . . replaces horizontal milling and boring machine that worked just one hole per setup. Interchangeable inserts allow operations on any of four different workpieces. One feed slide unit handles interchangeable heads. **Production — 10 pieces per hour . . . up — 400%.**

ELECTRIC POWER INDUSTRY

Two-spindle machine mills both inside and outside radii of curved alloy steel turbine blade section in a single pass *at three times the former feed rate.* Versatile 360° drum fixture handles 81 different blade sizes without overtravel on rapid stroke for extremely short cycle time. **Production up — 300%.**

Write for bulletin SMD-57 on your company letterhead or phone — GReenfield 6-8300 . . . Direct Distance Dialing Code No. 414.

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SPECIAL MACHINERY DIVISION

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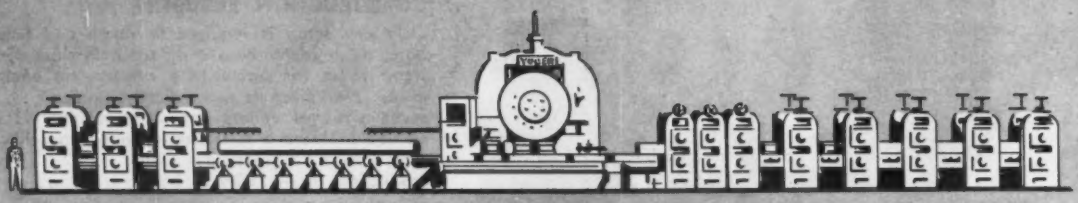
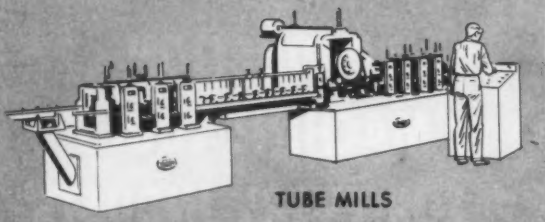
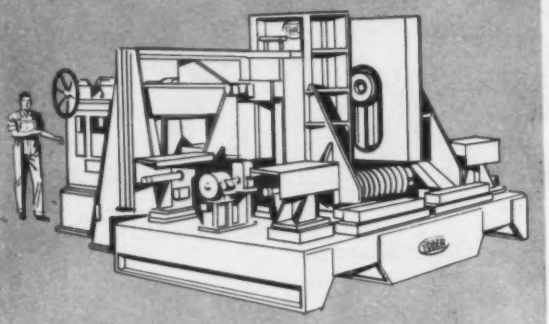
SINCE 1898 . . . *Kearney & Trecker Customer Engineering Service — supported by an outstanding staff of engineers experienced in production milling machine design and application — combined with the finest and latest machine tools in an ultra modern plant, is always ready to solve your production problems.*



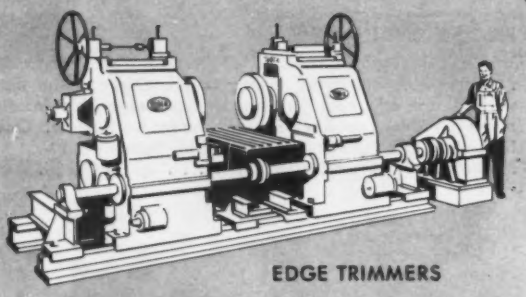
PIPE MILLS



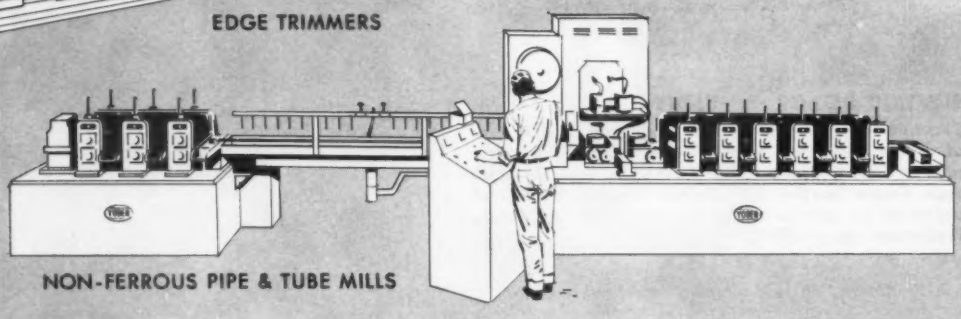
TUBE MILLS



HEAVY DUTY UNCOILERS



EDGE TRIMMERS



NON-FERROUS PIPE & TUBE MILLS

YODER PIPE AND TUBE MILLS

Today's expanding markets and tightening economy demand closer production cost control. YODER'S complete line of ferrous or non-ferrous Pipe and Tube mills can help you meet production schedules economically... help you realize significant savings in the manufacture of tube and pipe.

YODER Pipe and Tube mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16″ to 24″. Speeds up to 350 fpm plus can be obtained with YODER mills.

YODER also makes a complete line of Slitting equipment and Cold Roll-Forming machinery. Send for your copy of the fully-descriptive book covering Tube Mill operation.

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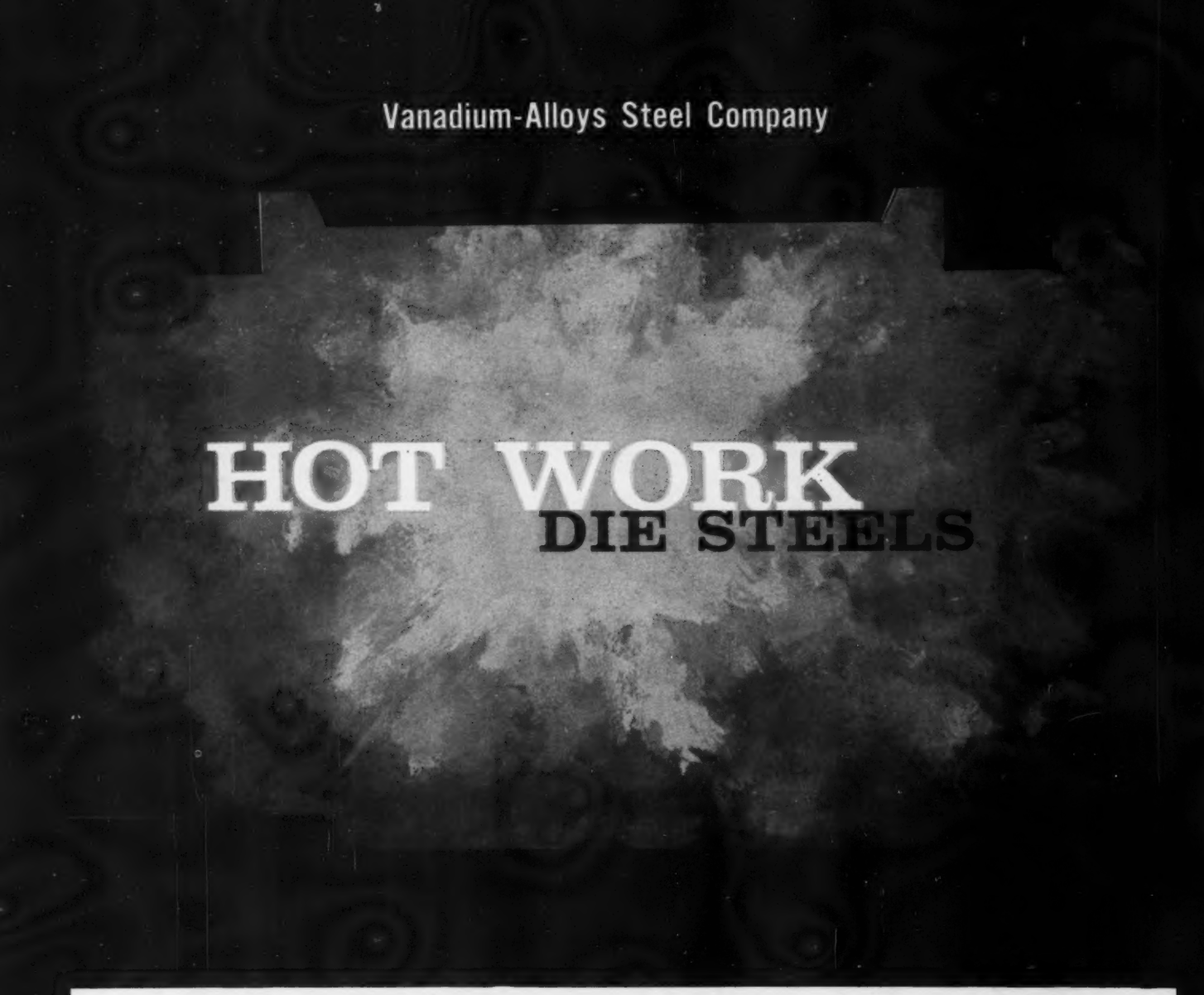
PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES

Vanadium-Alloys Steel Company



HOT WORK DIE STEELS

for your applications

that ask the most

of quality on the job

These are the leading die steels for hot work wherever high temperatures make life hard on dies. Their stamina, stability and resistance to wear have made them fixtures in the modern die shop—first choice consistently by men who know *first quality* in steel.

FORGE-DIE

14% tungsten. High resistance to softening at high temperatures. For piercers, punches, hot forming dies.

HOTFORM

Most widely used hot work die steel. 5% chromium. High strength, toughness, resistance to heat checking. Die casting, extrusion, and hot forging dies; mandrels, etc.

MARVEL

10% tungsten. High resistance to high temperatures. Punches, nut piercers, brass forging dies, etc.

HOTPRESS

Tungsten die steel with added high temperature toughness. Dummy blocks, upsetting dies, extrusion dies.

Vanadium-Alloys Steel Company

LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co.

SUBSIDIARIES: Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)

PREVIEW OF PROGRESS

NICE BALL BEARING COMPANY
Division of Channing Corporation
Towamencin Township, Montgomery County, Pa.

NICE PLANS LONG RANGE PLANT EXPANSION

First Unit to be Completed in 1959

Nice Ball Bearing Company, Philadelphia, Pennsylvania, a Division of Channing Corporation, has started construction of a new plant addition to be located in Montgomery County, Pennsylvania, approximately 30 miles north of the present Philadelphia plant. The first unit, scheduled for completion in 1959, represents Nice's fourth major expansion since the end of World War II and will provide approximately 40,000 square feet of additional manufacturing area. Future plans for the new location call for an ultimate completely integrated plant of approximately 340,000 square feet.

An unprecedented demand for Nice products has created a critical need for additional facilities. Completion of the new facilities now under way will add substantially to manufacturing capacity and will enable Nice to improve deliveries and provide better service to customers during the fourth quarter of this year.

One of the pioneers in the bearing industry, Nice Ball Bearing Company has been a nationally known manufacturer of ball bearings since 1902, producing bearings that are used in products throughout the world.

NICE

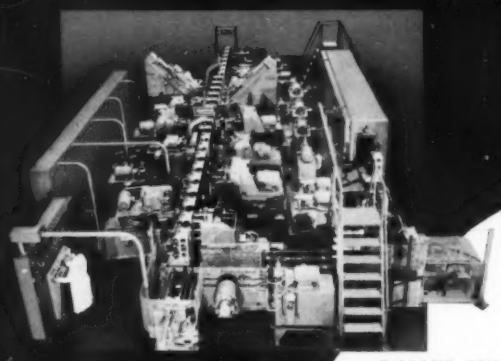
NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA
DIVISION OF CHANNING CORPORATION

Buhr ECONOMATICS are helping to put ECONOMY in the new

COMPACT CARS

Operating economies will be just as important to the compact-car buyer, as they are to the compact-car manufacturer. The high accuracy and low maintenance of Buhr Economatics assure a lower initial product cost through low manufacturing costs.

Production men know that Buhr special multi-operation machines save money all along the line. Simple controls and automatic cycles reduce operating costs; rugged components, 'building-block' construction and modern design protect the initial investment.



PALLET FIXTURES

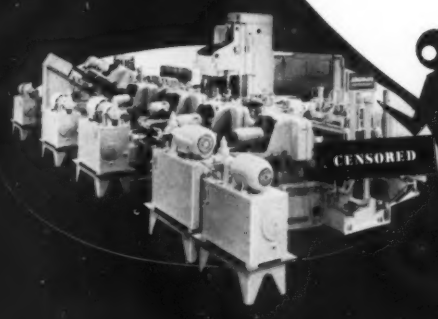
By clamping steering knuc pallet-fixture for complete machined dimensions bec tionships.

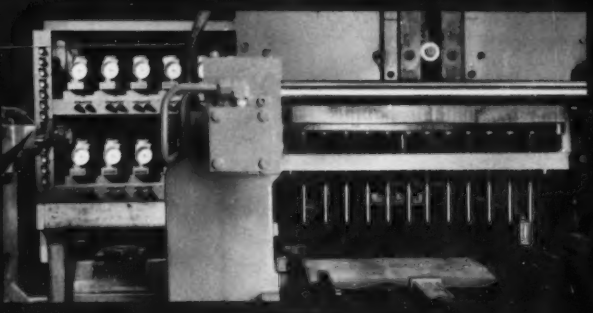
HIGH PRECISION

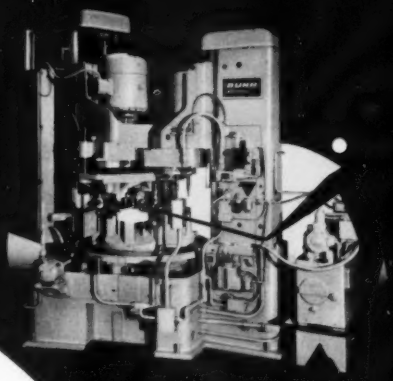
Positive micro-adjustable bility of hydraulic feed co stroke compensation after

FLOOR SPACE ECONO

Minimum area consistent maintenance is accentuated fer machine for compact-car







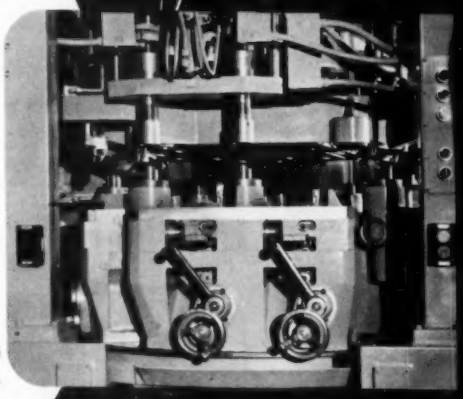
QUALITY CONTROL

Self-monitoring block line ejects out-of-tolerance parts. Three consecutive rejects cause machine to stop.

knuckles just once in
nplete machining, all
s bear proper rela-

HIGH VISIBILITY

Dial index machines compact-car flywheels with minimum fixturing. Operator can see everything even when safety guards are in place.



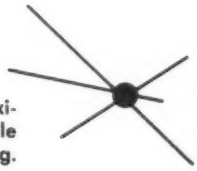


table stop and flexi-
ed combine for simple
after cutter grinding.

GUIDED TOOLS

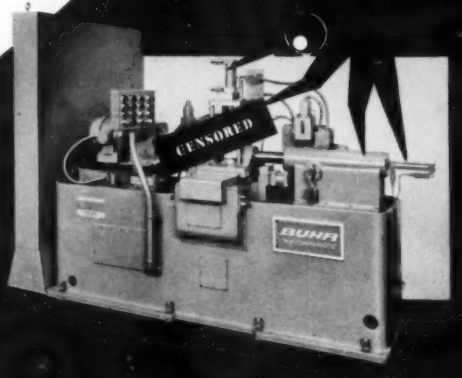
Compact-car steering knuckles accurately machined in rugged dial-index machine with all tool motions guided.

ONOMY

stent with ease of
uated by new trans-
ct-car cylinder head.

SPHERICAL MILLING

Small special-purpose machine mills internal seats on a compact-car part. Two-way machine has high production.



TIME SAVINGS

Compact-car cylinder blocks rotated around two axes during single index show time savings possible with proper design.

BUHR

MACHINE TOOL COMPANY specializes in the design and construction of practical versatile multi-operation machine tools.

Basic features stressed in all Buhr machine tools include:

QUALITY—rugged design and manufacturing accuracy are combined to provide long trouble-free operation.

CONVERTIBILITY—Buhr uses standardized "building-block" parts wherever possible in its machines, fixtures, etc. All such parts are held to interchangeability tolerances.

PRODUCTIVITY—dependability is designed and built into Buhr machines to insure maximum productivity per man-hour consistent with production requirements.

LOW DOWN TIME—every effort is made to minimize downtime by careful attention to future maintenance requirements, etc.

VERSATILITY—Buhr machines have a well-earned reputation in industry for their versatility. Many can produce a variety of parts with a minimum changeover time.

SERVICE Buhr welcomes the opportunity of discussing your machining requirements. Give us a call or drop us a line.

BUHR
MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN

BUHR

the symbol of quality in multiple operation high and low production equipment

more examples

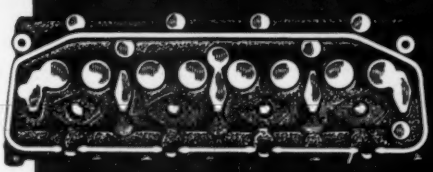
DIFFERENTIAL CASE

Differential case has two spherical cuts milled on internal surface, centered on bored holes. Production rate is 144 per hour.

Two-Way Machine #C-5253

All spark plug holes are combination drilled and reamed on a simple 2-fixture 2-station machine with a 12-spindle head.

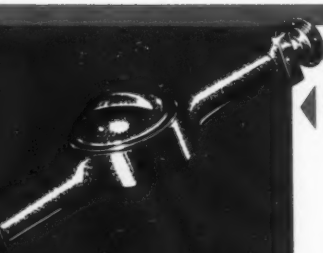
Two-Station Machine #C-4841



CYLINDER HEADS

Typical jobs on various *BUHR* Economatics

Any random selection is naturally incomplete. If you don't see a part that looks like yours, send us a part print and we will be happy to tell you what Buhr Economatics are doing to cut costs on your type of part.



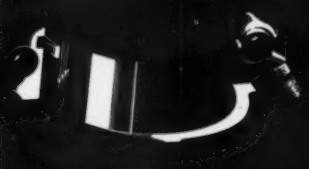
AXLE HOUSING

On this part, a short Buhr Economatic transfer machine has eliminated an annual retooling cost averaging $40,000 per year.

Short Transfer Machine #C-5188

Connecting-rod caps are made from steel forgings in 12 operations on an 8-station dial-index machine. Four caps are finished in an 18-second cycle and they can be used without preselection.

Dial Index Machine #C-4965



CONNECTING-ROD CAPS

APPLIANCE PARTS

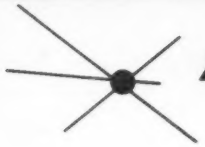
Washing machine gear segments and pitman drive have holes drilled and bored in a 16.5-second cycle.

Dial-Index Machine #C-5336

From 19 to 28 operations per part are performed on 32 different valve body styles on the same machine with only simple tool changes.

Trunnion Machine #C-5021

VALVE BODIES



BUHR MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN

Ask for more information by machine number

STEERING KNUCKLES

These tough steel steering knuckles must be machined carefully to prevent distortion. Two at a time come off a 16-station transfer after 26 operations.

Transfer Machine #C-4572

7 different road machinery parts are produced on one automatic machine. Settings for different parts are pre-selected with a dial switch.

Shuttle-type Machine #C-4552

ROAD MACH'Y PARTS

HALT

heat damage to carbide tipped tools

SIMONDS PLATE MOUNTED WHEELS

(OPEN STRUCTURE)

with NEW V9 BOND

Simonds GC Electrolon (green silicon carbide) grinding wheels are made with very open structure by a new method to produce the desired voids or pore spaces . . . for cooler, faster grinding.
The new V9 vitrified bond is a chemically designed glass bond more controllable for more uniform grinding action.
Furnished plate-mounted for all grinders. Typical specifications for carbide tool grinding: GC60-H12-V9 for roughing; GC120-H12-V9 for finishing.

CALL YOUR SIMONDS DISTRIBUTOR
Proven products
Dependable know-how
Quick supply

SIMONDS ABRASIVE COMPANY
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Division of Simonds Saw and Steel Co.

BRANCHES: CHICAGO • DETROIT • LOS ANGELES • PHILADELPHIA • PORTLAND, ORE. • SAN FRANCISCO • SHREVEPORT

For more data, circle this page number on inquiry card

THEY SPEND MORE pennies

TO MAKE MORE dollars

Without coolant, this Bullard lathe makes a .125 rough cut and .050 finish cut using Kennametal Grade K6 inserts in a Kendex* (patented) holder. Sand holes in the castings add to the difficulty of an interrupted cut. Photos and production data courtesy of American Coleman Company, Littleton, Colorado, manufacturers of trucks, tractors, front drive axles, and related parts.

	50 RPM 24 Minute Tool Life	88 RPM 15½ Minute Tool Life
Feed	.027	.027
Cutting Time:		
First side—rough cut	7 minutes	4½ minutes
First side—finish cut	7 minutes	4½ minutes
Second side—rough cut	5 minutes	3¼ minutes
Second side—finish cut	5 minutes	3¼ minutes
Total cutting time	24 minutes	15½ minutes
Machine cost per hour	$6.00	$6.00
Tool cost per hour	.075	.27
Machine and Tool cost/8 hours	$48.60	$50.16
Pieces finished per 8 hours	5	9
Cost per piece	$9.72	$5.57

KENNAMETAL* tooling permits 75% SFM increase... cuts cost per piece almost in half

Like many others, this plant is sacrificing pennies in tool costs to make dollars in production profits. At 50 rpm, this boring mill faced cast iron housings at a maximum speed of 289 sfm. Each Kennametal cutting edge faced both sides of two pieces with production averaging 5 pieces per 8-hour shift. When the maximum speed was increased to 510 sfm, the cutting insert had to be changed for each piece.

This reduction in machining time, plus some additional time saved by an improved method of holding the workpiece, enabled production to increase to 9 pieces per shift.

Sacrificing a few pennies of increased tool costs to make dollars in production profits is not a new idea. It has been proven-in-use by many progressive plants, and we will gladly send you records of such operations. These results can be duplicated in other plants where machines and talented operators have been held back by old ideas about tooling and tooling costs.

Ask your Kennametal Carbide Engineer how Kendex* (patented) tooling can help you get more efficient output from *your* machines . . . or write direct for the booklet, "There's Profit in Retiring a Tradition." KENNAMETAL INC., Latrobe, Pennsylvania. 97237

*Trademark

INDUSTRY AND KENNAMETAL ...Partners in Progress

WE DARE YOU TO TRY THIS

...with anything but a Clearing-Axelson Blue Chip Lathe

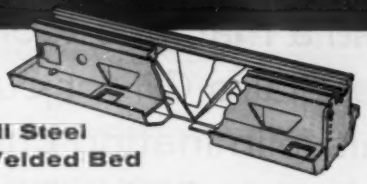
A spine smashing test—Yet we got precision results on this ¾" cut under conditions that would make any other lathe sway-backed.

Why bother to run a lathe suspended in air? Only to demonstrate the incomparable rigidity of the welded steel Clearing-Axelson Blue Chip lathe. This rigidity is absolutely permanent; it will maintain the precision of this machine through years of the most severe service.

And why, you may ask, is such enormous rigidity important?

Well, a lathe that can whistle its way through the toughest alloys yet provide vibration free operation has to be rugged. The Blue Chip lathe turns out more accurate work, faster—even when hogging off metal at a clip you would have thought impossible up to now. More horsepower permits use of latest tools—smooth, effortless operation saves you money on tooling.

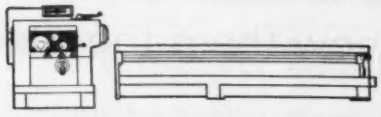
Clearing also manufactures the Clearing-Harrison lathe, presses of all types, dies and special tooling, and special equipment for the aircraft and missiles industry.



All Steel Welded Bed

Stronger steel plate provides strength where it is needed. Pyramid shaped reinforcing ribs are used the entire length of the bed for high torsional rigidity.

Modular Bed Construction



Headstock and bed on Blue Chip Lathes are built as separate units. Both are all steel weldments, fully stress relieved, and both are built-to-the-floor. That's how the Blue Chip lathe can laugh at obsolescence. Need a larger bed? Order a new bed but keep your existing headstock.

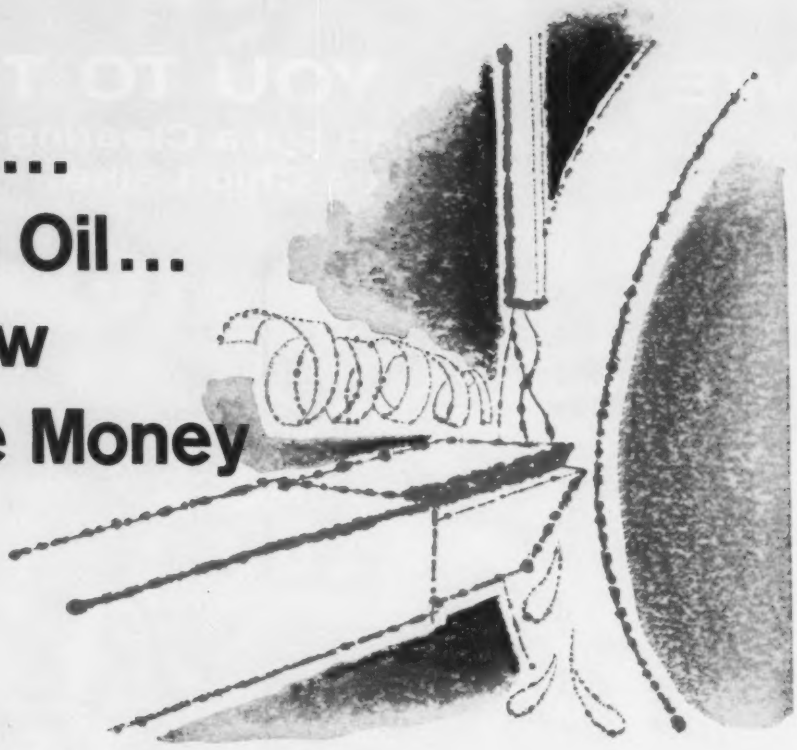
All the facts on the Blue Chip line of lathes are in this catalog. Write for your copy today.

USI Clearing

DIVISION OF U. S. INDUSTRIES, INC.

6499 W. 65th St. • Chicago 38, Illinois • Plants in: Chicago, Hamilton, Ohio, Los Angeles

Turning... Cutting Oil... and How to Save Money



You can cut costs by switching to the one oil that does the job of two—Sinclair Clairo Oil. This dual-purpose oil has earned a reputation as both a cutting oil and a machine tool lubricant. Moreover, you use the same Clairo Oil for cutting ferrous and non-ferrous metals, eliminating changeover and contamination. Tests prove Clairo Oil gives up to 200% greater tool life. Next time management asks how you've cut costs, tell them you're using Sinclair Clairo Oil—and show them the results.

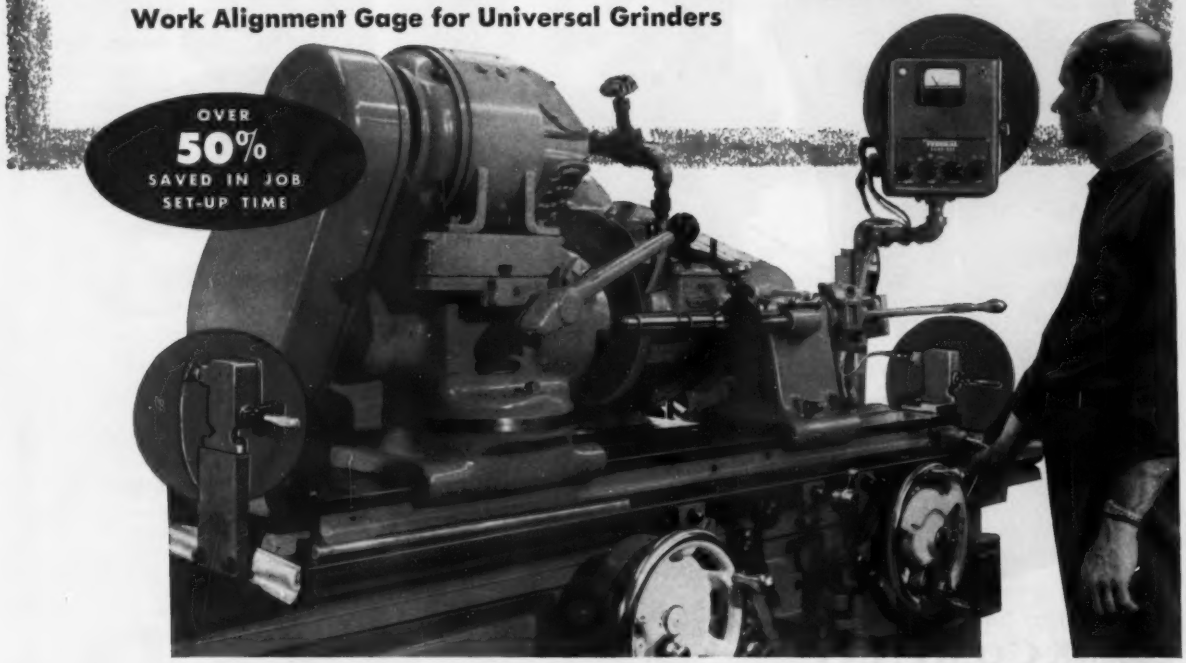
Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There is no obligation.

Sinclair

Sinclair
Clairo® Oils

the Sure-set FAST ACCURATE ABSOLUTE

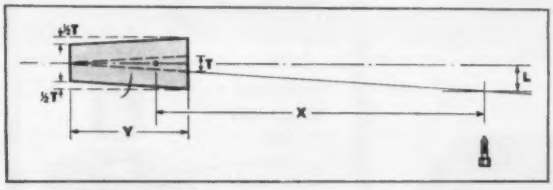
Work Alignment Gage for Universal Grinders



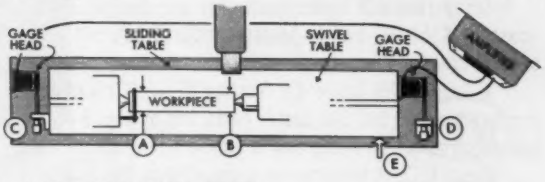
HOW THE SURE-SET PROVIDES *ABSOLUTE* CONTROL OVER WORK POSITIONING

(1) The Sure-Set is an electronic work-positioning gage which guides the operator in making the *exact amount* of swivel table adjustment needed to eliminate unwanted taper or — conversely — to produce a specifically desired taper, so that a part can be produced successfully *WITH ONLY ONE TRIAL CUT*. There is no restriction on workpiece length or table length.

(2) The Sure-Set shows the operator when he has made the table adjustment correctly by showing actual table position. And, because it shows how much *each end* of the table moves, the operator can make correct adjustment, EVEN THOUGH THERE IS PIVOT LOOSENESS, STICK-SLIP, OR ACTUAL BENDING OF THE TABLE . . . conditions which occur in MOST grinders.



(3) The Sure-Set electronically compensates for the difference between length of workpiece (Y) and the distance from table pivot to adjusting screw (X). This is important because it permits the operator to make the correct table adjustment (L) without first having to stop and calculate what it actually should be. The Sure-Set is able to save the operator this calculation by charts, graphs, and mathematics because its meter (graduated in .001" or .0001") reads in terms of the workpiece taper (T) which he already knows.



A HARD JOB MADE EASY

The Sure-Set saves over 50% set-up time by eliminating trial-and-error grinding and repeated checks. Here is the procedure: Take trial cut . . . gage work at two points (A and B) to determine taper . . . set compensating switch on Sure-Set amplifier to match distance between A and B points . . . watching meter on amplifier, zero each gage head by adjustments at C and D . . . adjust swivel table at E until meter reading for *each* gage head matches the amount of taper . . . TAKE FINISH CUT. Total elapsed time — 2 to 3 minutes!

You'll be amazed how much time and money the Sure-Set can save! For further information contact your local FEDERAL representative or write . . .

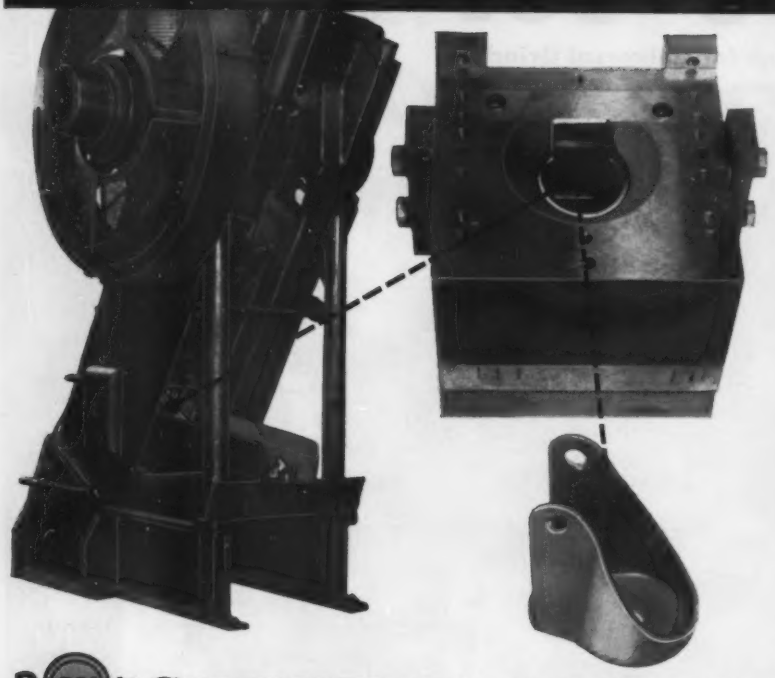
FEDERAL PRODUCTS CORPORATION
91111Eddy Street, Providence 1, R. I.

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .
Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

For more data, circle this page number on inquiry card

Talide® DIE IN SERVICE 8 YEARS DRAWS 9,000,000 CASTER PARTS!



Bassick COMPANY, Bridgeport, Connecticut, leading producer of casters, chair controls, automobile and specialty hardware, was experiencing difficulty drawing an eccentric shaped chair caster part from commercial quality hot rolled drawing steel.

Scrap rate was high—production per die low. The high-speed steel die being used (costing $350.00) had to be reground and polished every 30,000 pieces, and replaced several times a year.

A Grade C-85 Talide die (costing $1100.00) was installed in 1950 and to date has produced over 9,000,000 caster parts. During this 8-year production run, the Talide die has required no servicing and is still in operation.

Bassick Company engineers report that the quality of their product has been improved. Surface marks and scratches, caused by scoring and galling of the steel dies previously used, have been completely eliminated.

A Talide die engineer can help you cut costs and increase production on draw presses, punch presses, pill presses, cold headers, swagers and draw benches.

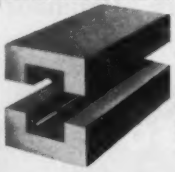
METAL CARBIDES CORPORATION
6001 Southern Boulevard Youngstown 12, Ohio

Send for 76-Page Catalog 56-G

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 12, OHIO
HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

WIRE DIES

Hundreds of miles of steel and non-ferrous wire—.004 to .750—drawn through TALIDE dies.



SWAGING DIES

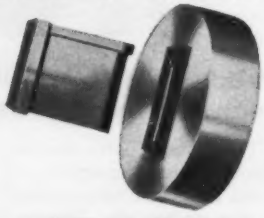
Leading fountain pen manufacturer cold swages 33 times more stainless steel parts with TALIDE dies.

HEADING AND EXTRUSION DIES

Cold heading ¼" C-1008 rivets, TALIDE dies produced 11,200,000 pieces, other carbide dies only 3,500,000.

CURLING ROLLERS

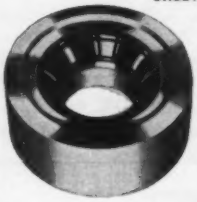
TALIDE curling rolls last 65 times longer than steel rolls on beverage can forming operation.



BLANKING AND FORMING DIES

70 times more paper discs blanked out with TALIDE—over hard alloy die.

SHEET METAL DIES

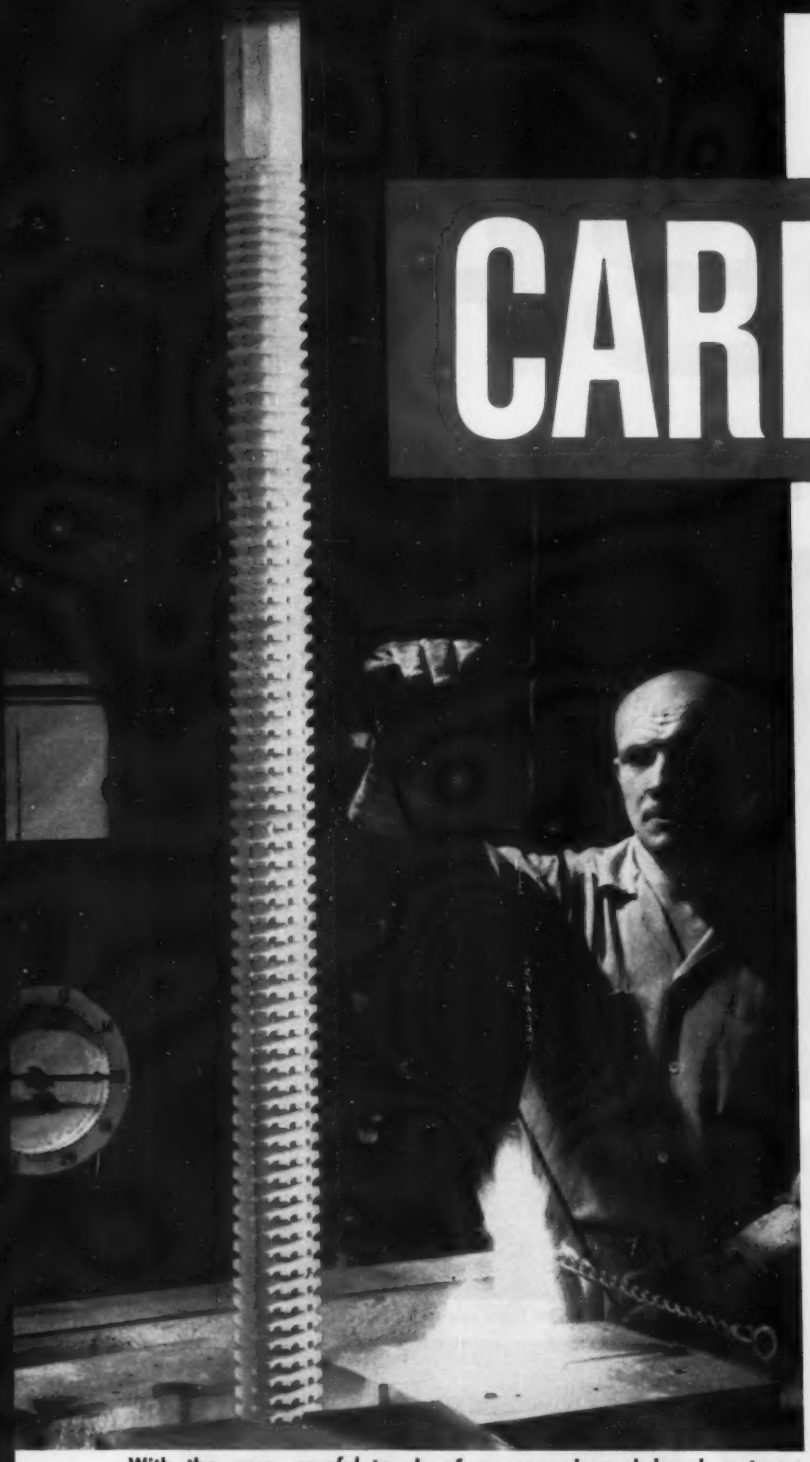


137,000 hi-alloy steel pressure vessels drawn with TALIDE against only 7,900 with steel dies previously used.

POWDERED METALLURGY DIES

Compacting highly abrasive chemical powders, TALIDE pill dies last 4 months; steel dies wore out in 6 hours.

CAREFUL!



With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard and custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut downtime and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

59-14

CTW

Continental TOOL WORKS

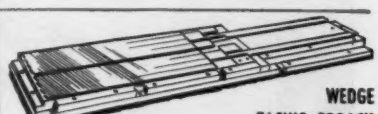
DIVISION OF

EX-CELL-O CORPORATION

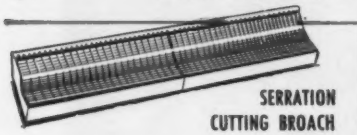
DETROIT 32, MICHIGAN

PINETREE FORM BROACH

SPIRAL SPLINE BROACH

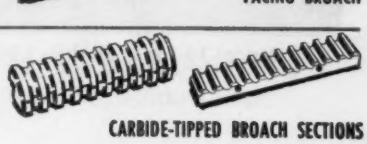


WEDGE FACING BROACH



SERRATION CUTTING BROACH

INVOLUTE SPLINE SHELL-TYPE BROACH



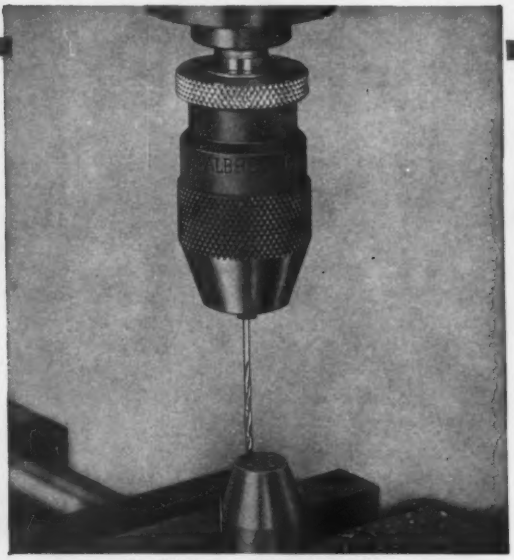
CARBIDE-TIPPED BROACH SECTIONS

ALBRE

The world's most accurate keyless

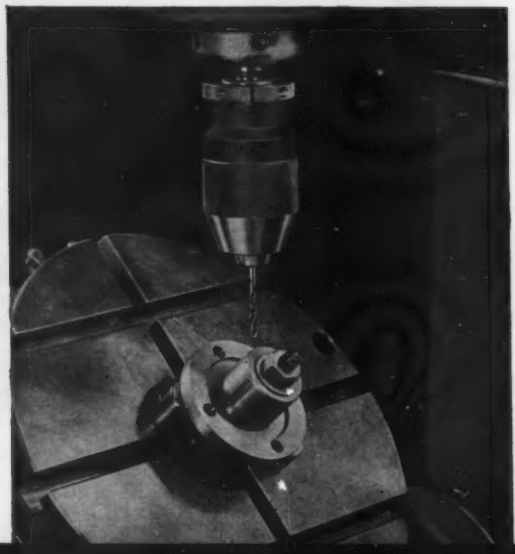
On milling machine

The Albrecht Drill Chuck at work in production and in the tool room.



On high speed sensitive drill

Model 15 for small drills (.008" shank)



On jig borer

CHT

drill chuck!

Albrecht Heavy Duty Drill Chuck

8 threaded back models—capacities 0-⅝"

12 taper mounted models—capacities 0-⅝"

Now available in threaded back models for portable tools

INDUSTRIAL DISTRIBUTORS
SERVING INDUSTRY ECONOMICALLY
THE RIGHT HAND OF PRODUCTION

A PARTNERSHIP IN PROGRESS

Your industrial supply distributor makes it his business to know your business. He is always available and ready to fill your needs quickly, dependably and economically. When you need chucks, you can depend upon Jacobs and the Jacobs industrial supply distributor who works with you... your partner in progress through service.

Jacobs
CHUCKS

The Jacobs Manufacturing Company
West Hartford 10, Connecticut

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UNIVERSAL DRILL BUSHINGS

industry's standard of quality and service

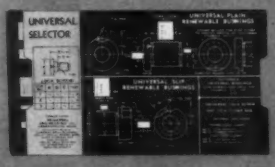
All standard sizes and lengths available for immediate delivery.

100% concentricity and hardness tests insure accuracy.

Knurled heads provide good grip.

Write for free catalog describing Standard Drill Bushings, Standard Collet Chucks, Floating Collet Chucks, Boring Chucks, Kwik-Switch Tool Holders, Mikro-Lok Boring Bars, Index Plungers and other Universal Products.

Superfinishing of Universal Drill Bushings is an important factor in keeping tool and bushing wear to a minimum . . . especially in close tolerance work. Blended radius helps prevent tool hang-up.



The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size. Request your calculator—free—on your company letterhead.

208

UNIVERSAL ENGINEERING COMPANY | FRANKENMUTH 2, MICHIGAN

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HARDINGE
ELMIRA, N.Y.

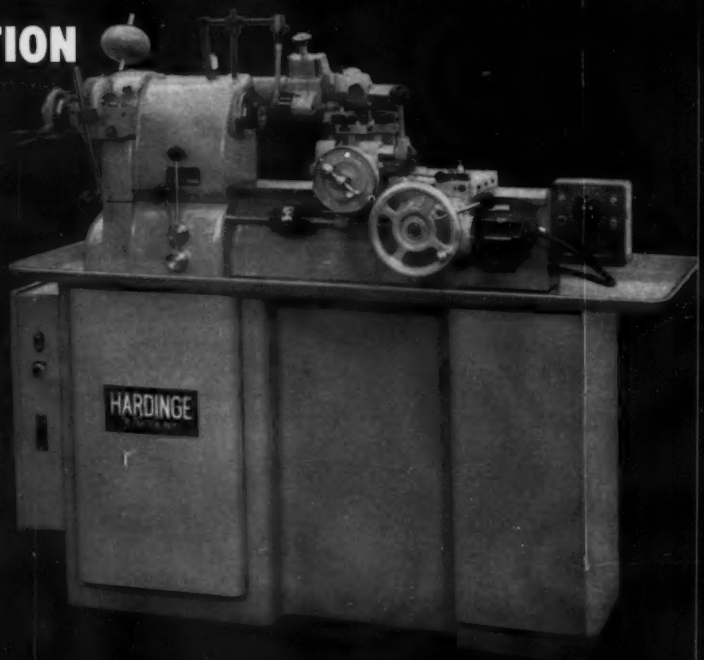
HARDINGE EASY READING BLACK and WHITE DIALS

mean INCREASED PRODUCTION

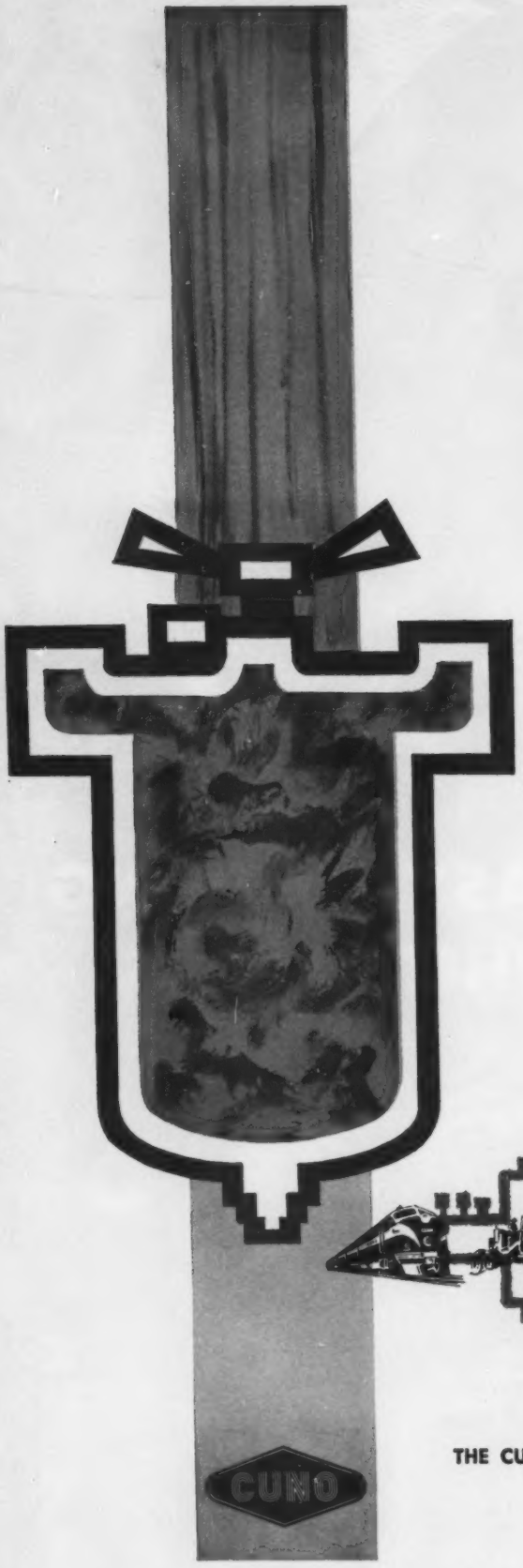
. . . **HARDINGE** developed these fast setting easy reading **black and white dials** – they assure maximum accuracy with high production.

Pioneered with the Hardinge High Speed Precision Chucking Machine model HCT shown here – **Hardinge black and white dials** are now standard equipment at **no extra cost** on all of our tool room and production machines.

Invest in Hardinge equipment for product improvement and increased production. Ask for bulletin on our tool room and production machines.



HARDINGE BROTHERS, INC.
ELMIRA, N. Y.

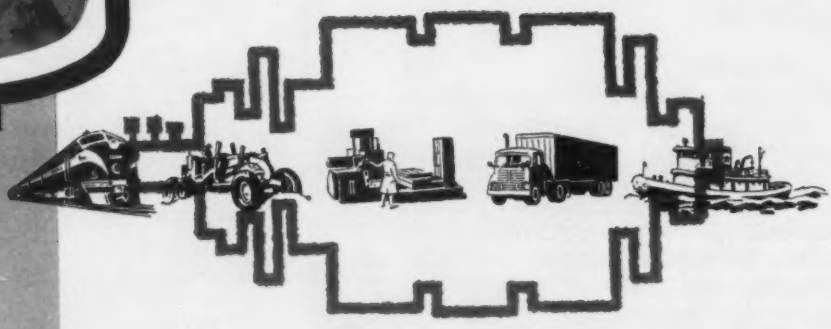


whatever the
power production application . . .
you can depend on
CUNO
engineered filtration

"The more complete the filtration, the more efficient the production of power." Cuno filters remove damaging contaminates and reduce costly stoppages.

To meet the specific requirements of *your* power production application, Cuno provides effective, engineered filtration with . . . Auto-Klean Self-Cleaning Edge-Type, Flo-Klean Automatic Self-Cleaning Wire Wound, Micro-Klean Disposable Depth Cartridge . . . available in a variety of housings.

Let us apply over 30 years of filtration know-how to *your* requirements.



THE CUNO ENGINEERING CORP., DEPT. 11, MERIDEN, CONN.

A Leader in Industrial Filtration for More Than 30 Years

Sales Offices throughout the United States and Canada
In Canada write: Peacock Bros., Ltd., P.O. Box 1040, Montreal 3, P.Q.

Kingsbury machine cuts handling, makes big savings on Dexter locks

"Too much handling of lock parts causes nicking and burring. Then the assembled locks bind and we have to rework them," says Dexter Industries, Inc., of Grand Rapids, Michigan.

"Our new Kingsbury has cut our handling way down, eliminating nicks and increasing production by combining several operations in two chuckings of the work. We're delighted with it."

Each part passes twice around the machine. In the first chucking horizontal units at six stations drill the six pin holes, locating within .001. In the second chucking vertical units operate a broach and a combination tool. The last operation deburrs the pin holes; an air cylinder pushes removable pins on a block into the six pin holes.

Typical of what we can do for you. This setup resulted from the joint efforts of our sales engineers and representatives with Dexter's engineers and production men.

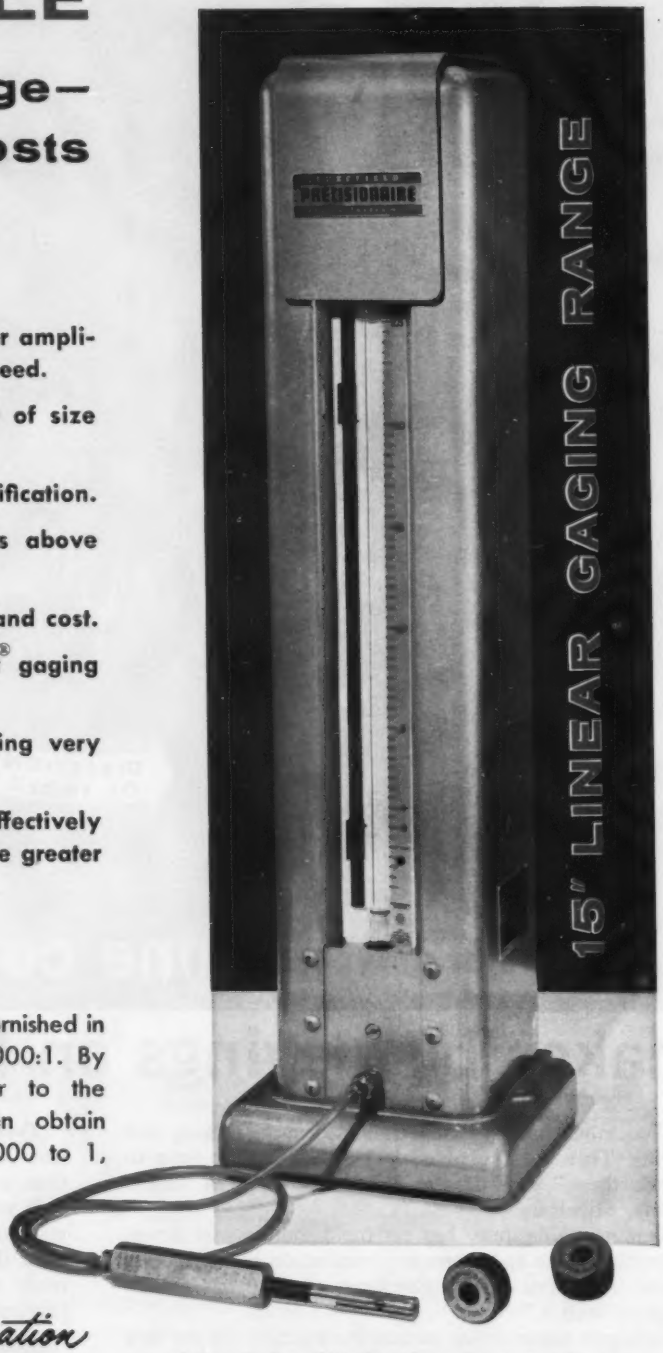
If you have drilling type operations in high production, may we make a proposal? Your Kingsbury will have good basic design and accurate rugged construction. It will be ready to produce when you receive it and will keep on producing. Kingsbury Machine Tool Corp., Keene, N. H.

KINGSBURY MULTI-UNIT AUTOMATICS

New LONG-RANGE PRECISIONAIRE®

with 15" LINEAR SCALE

Triples Gaging Range— Cuts Inspection Costs



Cost Saving Benefits

This new idea enables you to:

- **Inspect wider part tolerances at higher amplifications with greater accuracy and speed.**
- **Classify parts into a greater number of size increments.**
- **Widen the scale spread for each classification.**
- **Accurately measure those deviations above and below tolerance limits.**
- **Reduce gaging equipment inventory and cost.**
- **Double the amplification of Plunjet® gaging cartridges.**
- **Obtain full amplification when gaging very small diameters.**
- **Watch machining operations more effectively with in-process gaging because of the greater come-up or approach interval.**

Broad Amplification Range

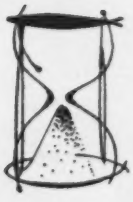
The new Long-Range Precisionaire Gage is furnished in standard amplifications of 5,000:1 or 10,000:1. By adding the Sheffield Pneumatic Amplifier to the 10,000:1 Long-Range instrument, you can obtain 20,000, 40,000, 50,000, 80,000 or 100,000 to 1, amplification.

8362

the SHEFFIELD corporation
of Bendix Aviation

manufacture and measurement for mankind

Call your local Sheffield representative for a demonstration or write to the Sheffield Corporation, Dayton 1, Ohio, U. S. A., Dept. 9.



Every Year: *the whiskers on America's old lathes grow longer!*

... And as a manufacturer don't you find imports and substitutes grabbing more and more of your markets every day? Largely on a price basis?

Any connection between antiquated lathes and lost markets? You know it!

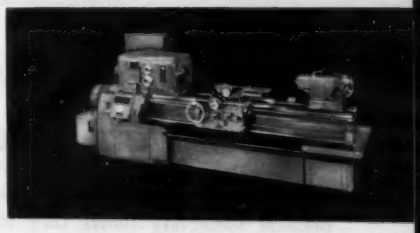
Consider these alarming facts. In 1945, 38% of all America's machine tools were ten years old or older. In 1953, 55%. In 1958, 60%. Yes, 60%!

The lathe story is even more disturbing. Right now 72% of all engine lathes are over 10 years old. Almost 40% of these are over 20 years old.

Think of that in terms of productivity. A twenty-year old 16″ slowpoke, with a 7½ H.P. motor, delivers a top metal removal rate of 9½ cubic inches per minute. A ten-year old with 10 H.P. delivers a 15 cubic inch rate. *And yet today's Monarch 20 H.P. job throws chips at a 36 cubic inch rate.*

There are other factors, too. With old machines, the cost saving advantages of throwaway tools and negative rakes cannot be realized. High temperature alloys and many other materials cannot be turned economically without today's oxide and harder TiC carbide tools. And savings on modern lathes with tracer controls are phenomenal.

As never before, American industry must today study every avenue of possible cost reduction. For some, it may be a matter of sheer survival. Ancient lathes will not help meet tomorrow's competition. Modern Monarchs will ... *The Monarch Machine Tool Company,* Sidney, Ohio.



Not one of these MODERN MONARCHS was available 5 years ago. Some, not even a year ago.

Series 62 Preselector Dyna-Shift Lathe
Series 80 Heavy Duty Dyna-Shift Lathe
Series 90 Heavy Duty Dyna-Shift Lathe
Series 180 Ultra-Precision Contouring Lathe
The Missile Master
Rotary Profile Tracer Lathe
... And Others

Monarch
ACCURACY • ECONOMY • LONG LIFE
TURNING MACHINES

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

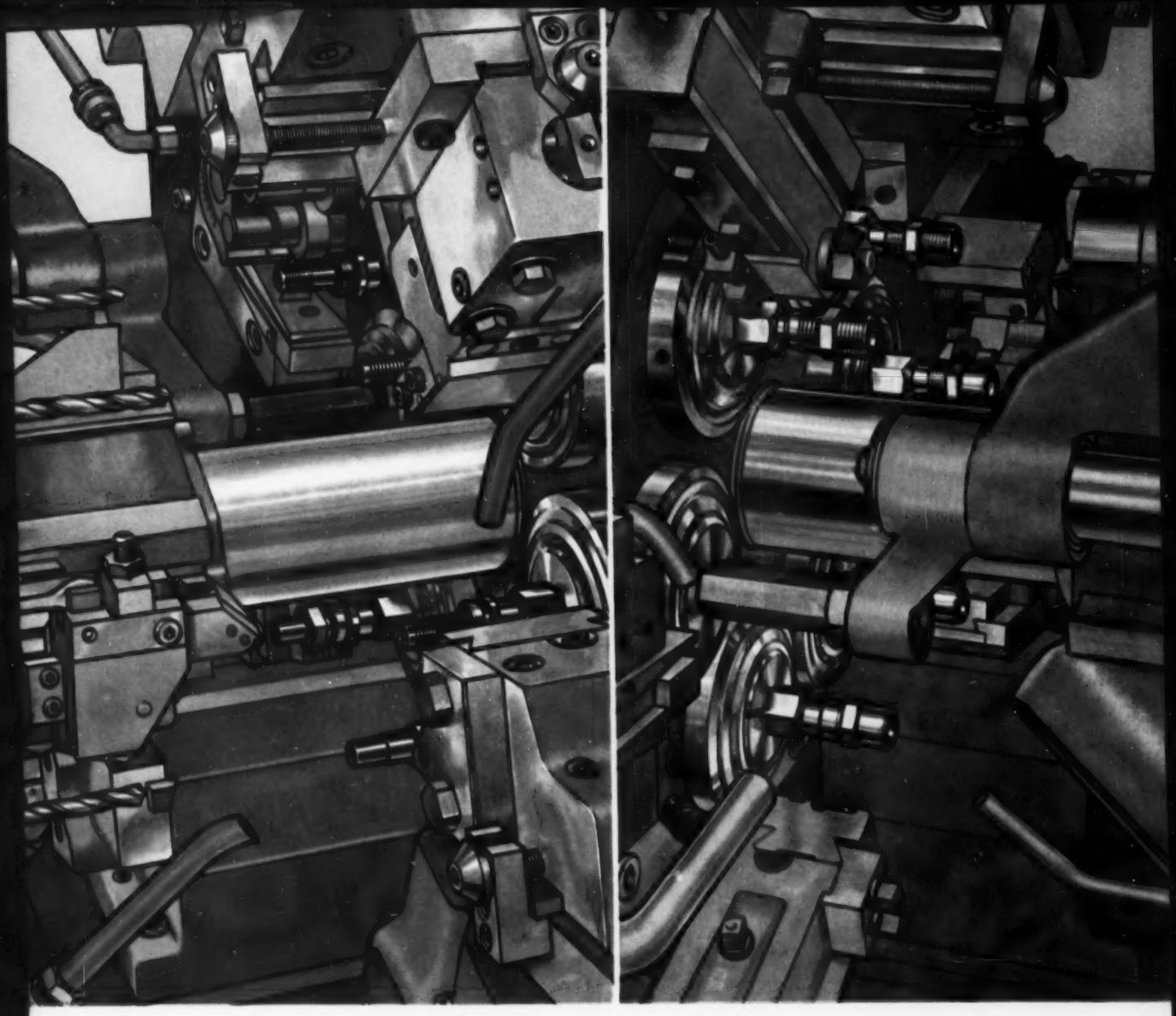
seven *surfaces to turn:* **one** *template,* **one** *slide,* **two** *tools.*

Machine tools are rarely if ever bought because somebody thinks they might come in handy. They are bought because a specific job needs to be done and because a particular machine is judged best fitted to do it. However, no matter how specific your need may be, *versatility* is the greatest by-product you can buy, and the greatest assurance of a profitable investment.

Perhaps your problem is economical, long-run production of a contoured shaft piece. Well and good: your best bet is a New Britain +GF+ copying lathe. Now let's suppose you develop a requirement for only a few hundred pieces like the one illustrated. Your New Britain +GF+ is every bit as efficient. Simple tooling; fast setup; rapid, accurate production.

The applications for contour turning are very broad. If you have contour turning, boring and facing work on shafts or chucking work, you should be interested in the New Britain +GF+. Many shops whose production requirements wouldn't justify very expensive, lightning-fast production can make highly profitable use of one of the basic models because of its versatility, accuracy, fast setup and inexpensive tooling. At the other end of the scale,

you can't touch our machines for tremendous volume work. Obviously, this subject is much too broad and too important to do justice to it here. We would like to send you literature that spells things out in much more detail. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

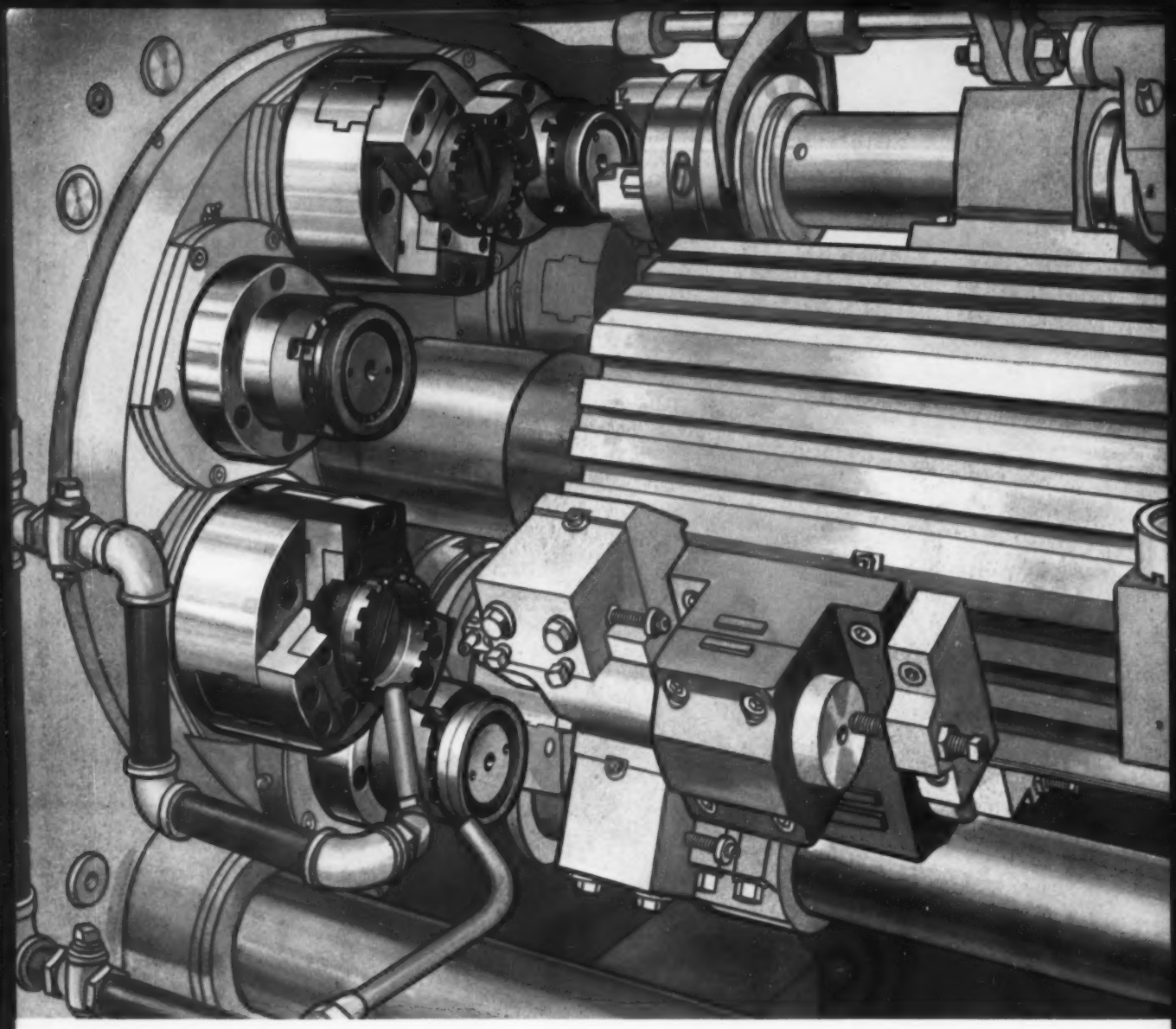


stainless, **225** *per hour—brass* **1500** *per hour.*

Up to a point increased machine productivity is a matter of refinements, additions, skillful tooling and perhaps more power. Eventually you achieve about all the efficiency that can be built into equipment of conventional design.

To achieve a major break-through in bar machine productivity necessitated redesign from the ground up. New Britain has done it with such success that we are able to offer the metalworking industry a whole new family of machines with performance unequalled anywhere. Independently cammed cross slides open up a whole new world of tooling possibilities. Power and spindle speeds are adapted to the important new metals and alloys. Increased chucking capacity allows application of New Britain standards of speed and accuracy to much larger pieces. None of the famous New Britain exclusive features which preserve accuracy and increase accessibility over other machines have been sacrificed. The chart below tells part of the story, and we have complete literature available to spell it out completely on the models which interest you particularly. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.	Weight
45	4	4	43-526	5″	30-50	46,000
52	6	6	271-4250	1 1/4″	15-25	12,800
62	6	6	177-3000	1 5/8″	15-30	18,800
62	6	6	177-3000	2 1/4″	20-30	18,875
82	6	6	64-633	3 1/2″	30-50	46,000
83	8	6	99-1504	2 5/8″	30-50	46,000



open secret *of New Britain superiority.*

Wide-open design makes the most fundamental difference between a New Britain automatic chucking machine and other machines. It speaks for itself as a means of getting at the tooling, making adjustments and clearing chips.

Massiveness, right from the floor up, is equally apparent and equally important in chucker work. You see it in the way the cutting tools make the heaviest cuts with a chatter-free smoothness that can't be duplicated.

Only New Britain provides a combination of longitudinal with transverse forming motion where needed. This versatility eliminates the need for second operation machines in many cases —particularly when a job is setup for double indexing, as illustrated above.

New Britain spares no pains to incorporate every new development to make chucker-type machining more profitable. The open-end design lends itself particularly well to magazine loading and unloading, for example, and many New Britains are being equipped to provide this feature.

Whenever a number of operations are required on cast or forged pieces, these massive, rugged, powerful machines offer great possibilities for savings through faster, more accurate, more reliable production. A new and complete catalog on the New Britain chucker line is just off the press. We would be very glad to send you your copy. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Announcement

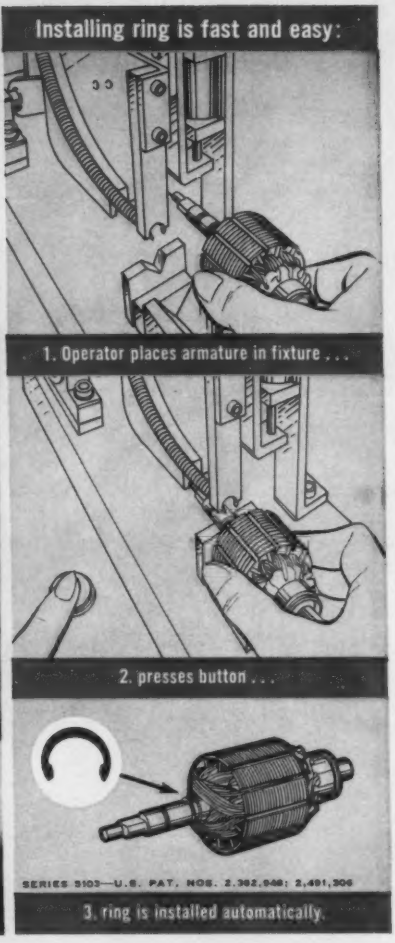
New Britain's new and completely modern Rebuild-Retool Center at Bridgeport, Michigan, is important to every present and prospective owner of New Britain Automatics.

This is the first center established exclusively for the rebuilding and retooling of production machinery. It is staffed by men trained specifically for this type of work. It is equipped specially for putting New Britains back on the job with maximum efficiency in minimum time, at minimum expense to the owner.

Rebuilding and retooling may be "orphan jobs" elsewhere, but they rate top treatment at New Britain. Here is an important extra reason for selecting a New Britain when you purchase new equipment—a full time specialist organization devoted to protection of your investment.

If you would like to investigate the profit potential in a complete modernizing program, or could profit from a factory-engineered retooling of one or more machines, write us either at New Britain, Connecticut, or Bridgeport, Michigan. The New Britain Machine Company.

For more data, circle this page number on inquiry card


Installing ring is fast and easy:
1. Operator places armature in fixture . . .
2. presses button . . .
SERIES 5103—U.S. PAT. NOS. 2,362,948; 2,491,306
3. ring is installed automatically.

Mechanized Truarc ring installation speeds assembly

eliminates costly shimming and gauging operations

Fast, semi-automatic assembly and the elimination of costly production operations are among the benefits Leece-Neville Co., Cleveland, Ohio, derives from the use of Truarc retaining rings in the manufacture of its fractional horsepower automotive motors.

Radially-assembled Truarc Series 5103 Crescent® rings—supplied pre-stacked—are used to position and lock the armature in the motor housing. Using the special Truarc pneumatic applicator-dispenser illustrated above, the operator merely inserts the rotor and presses a release button. The ring is installed automatically in a pre-cut groove on the rotor shaft!

The precision manufactured Truarc rings, seated in accurately located grooves, reduce accumulated tolerances from a possible maximum of .184" to .025". Costly, time-consuming shimming operations previously necessary to take up end play are eliminated, together with as many as four gauging operations required to select and place the shims.

The Leece-Neville story is just one example of the way Truarc retaining rings are stepping up production on today's fast-moving assembly lines. These versatile fastening devices simplify design, speed assembly and eliminate rejects. In replacing conventional fasteners, they often improve product performance and reliability. All of these advantages are in addition to substantial cost savings!

Truarc retaining rings come in 50 functionally different types . . . up to 97 different sizes within a type . . . 6 metal specifications and 13 finishes. Special Truarc hand, magazine and automatic applicators and grooving tools make production-line application easy on virtually every type of product. Make sure you have on file the new 16-page Truarc assembly-tool catalog No. AT 10-58. Write for your copy today. And remember Waldes Truarc engineers are always ready to assist you with your special production problems. Write: Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, New York. 9.13

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N.Y.

TRUARC RETAINING RINGS . . . THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

©1959 WALDES KOHINOOR, INC.

ALL TYPES AND SIZES

Here at Federal, we're proud fathers to over 12,000 different sizes of ball bearings and hundreds of types. A fine family and still growing, (not that we want to boast.) 12,000 strong, they stand ready to satisfy almost any application need that American industry can think of (and believe you us, American industry can think of some lulus). Would you like to meet the Federal family? We just happen to have their pictures — and names and numbers — in the form of a handy catalog which we'll ship you at the drop of a letterhead. Best looking, hardest working bunch of ball bearings you've ever seen. Write for it today.

THE FEDERAL BEARINGS CO., INC., Poughkeepsie, N. Y.

Federal

BALL BEARINGS

One of America's largest ball bearing manufacturers

FEDERAL ON FILM—A 16 mm. color sound film takes you through our 400,000 sq. ft. plant. Loaned free. Just ask for it.

Products of Precision by CADILLAC GAGE

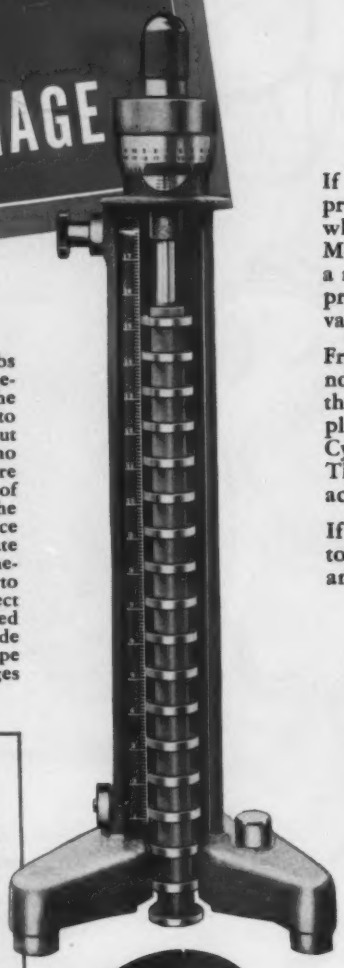
If it's precision you want—guaranteed precision—you've come to the right place when you specify Cadillac Gages and Measuring Instruments. For Cadillac is a name built over the years on accuracy, precision, quality, long instrument life, value and economy.

From the famous PLA-CHEK Gages, now proved in hundreds of plants throughout industry, through the complete line of Thread Ring, Thread Plug, Cylindrical Ring, Cylindrical Plug, Pipe Thread and Concentricity Gages, neither accuracy nor quality is ever sacrificed.

If your operations require really close tolerances, specify Cadillac Gages . . . and get guaranteed accuracy.

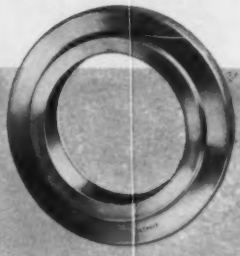
PLA-CHEK GAGES

In thousands of installations on innumerable jobs PLA-CHEK Gages are daily proving their time-saving and money-saving advantages, both at the surface plate and the machine. Extremely easy to operate—and fast, too,—PLA-CHEK Gages cut inspection time from minutes to seconds with no loss of accuracy. No auxiliary gage blocks are necessary. PLA-CHEK'S measuring bar is made of deep-frozen, strain-free alloy steel. Steps on the bar are exactly 1" apart. Because of its one-piece construction, steps cannot change or separate with age. Adjustment of the bar is by the micrometer thimble at top. Since it is not necessary to touch the measuring bar, body heat cannot affect it. All reference surfaces are ground and lapped to extremely close tolerances. Precision-made risers, which give PLA-CHEK even more scope and are engineered as accurately as the gages themselves, are available for all models.



COMPLETE RANGE OF SIZES

PLA-CHEK Gages are available in a full range of sizes to meet every inspection or surface plate layout requirement. Models are: The easily portable 6", 12" and 18" sizes, each guaranteed accurate throughout its entire range to .00005"; the 24" guaranteed to .0001" over its entire range; and the 36" and 48" sizes guaranteed accurate to .0001" in any 24" length or .0002" over their entire range.



CYLINDRICAL RING GAGES

Deep frozen for stability and long life, Cadillac Cylindrical Ring Gages reproduce assembly conditions exactly.

THREAD PLUG GAGES

Full length of gaging member is available for inspection. Worn or damaged end may be reversed in collet. Available in a full range of sizes.

THREAD RING GAGES

Manufactured of the finest alloy steel, these gages are heat and cold-treated for maximum stability. They are carefully lapped and closely inspected under controlled conditions.

CYLINDRICAL PLUG GAGES

Available in a full range of sizes, these cylindrical plug gages provide unconditionally guaranteed accuracy.

Cadillac GAGE COMPANY

P. O. BOX 3806 • DETROIT 5, MICHIGAN

NEW 5"-10" BENDING ROLLS ...produce cylinders with work-saving ease and cost-cutting speed

Model 5-60 (5' x 60")

Model 10-120 (10' x 120")

NIAGARA

Sleek, massive and low-built, these modern machines form commercially true cylinders with utmost speed and operating ease.

Adjustments for thickness and curvature are made quickly. A three-roll gear train keeps gears continually in mesh. Curving starts easily. Work in the rolls can be stopped instantly, reversed rapidly, or jogged in short increments . . . *at the touch of a button.* No drifting! Operation is quiet: Silent worm gear drive runs in a sealed bath of oil. Fully formed cylinders are easily removed via an air operated drop end. Performance is vibration-free: No foundations or floor bolting necessary.

Built in 5, 6, 7, 8, 9 or 10 in. diameters, Niagara Bending Rolls handle materials up to 14 ft. long and ⅞ in. thick. For complete information, request Bulletin 77.

MAKE YOUR OWN COMPARISON

with these standard and special features

- **Silent, totally enclosed worm gear drive**
- **Rugged, all-welded steel construction**
- **Full length, emergency stop treadle**
- **Three-roll gear train speeds work, protects quality**
- **Air operated drop end for easy removal of cylinders**
- **Quick, lower pinch roll adjustment**
- **Rear roll power adjusted, with indicators to duplicate settings**
- **Pinch type rolls minimize flat spots**
- **Longitudinal grooves permit one-pass forming of small diameters**
- **Pushbutton controls, conveniently located at operator's station**
- **High torque main drive motor with magnetic brake and reversing control**
- **Centralized pressure lubrication**

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N.Y. • District Offices and Distributors in principal U.S. cities and major foreign countries

PRECISION GRINDERS

MICRO MATIC
HONE CORPORATION
DETROIT, MICHIGAN

MANUFACTURED BY
JONES-SHIPMAN
LEICESTER, ENGLAND

FEATURES:

- Roundness to .00001″
- Surface finish to 1 micro-inch
- Parallel grinding to within .00025″ in the center over 24″.
- Shockless table reversal at all speeds.
- Table reversal accuracies: .0005″ for models 1300 and 1310, and .001″ for model 1305, at maximum table speeds.
- Micrometer movements on table and cross traverse.
- Trouble-free, low-pressure hydraulic system.
- Nitralloy wheel spindle running in plain bearings.
- Super-accurate workhead spindle in selected plain bearings.
- Minimum stroke of .020″ at maximum table speed.

PRECISION + VERSATILITY + EASY OPERATION =GREATER GRINDING EFFICIENCY

Models 1300, 1305 and 1310 are precision grinders that offer unusual versatility and ease of operation. They assure high grinding efficiency on such operations as: external cylindrical or taper, internal, and cutter or tool grinding. Of simple, accurate and rugged design, these grinders are available in three capacities: 8″ swing and 18″ between centers; 10″ x 27″; and 10″ x 40″.

SEVERAL types of wheelheads of proven design are available. Also, special attachments to efficiently meet any grinding requirement can be furnished.

FOR FURTHER INFORMATION, WRITE FOR YOUR COPY OF BULLETIN 208M

PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

From ROUGH BLANK to FINISHED GEAR *In 5 Seconds*

How? a New Red Ring Broaching Process

ACCURACY:

Pin size to .0009″

Lead to .0008″

Involute error .0003″

Composite error less than .001″

FLOOR–FLOOR: 15 Seconds

CHARACTERISTICS: 87 teeth, 24 pitch, 22° helix, 4″ O.D., ¾″ face—cast iron.

TOOL LIFE: After broaching 26,000 parts, this broach was resharpened by the removal of only .010″ of metal. In other cases, production would be governed by operating conditions.

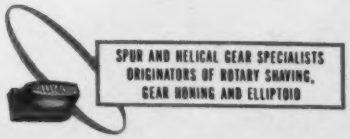
REPLACES SIX HOBBING MACHINES

8168

The above are actual production figures showing the possibilities of this amazingly effective broaching process.

The consistent precision and speed attained do not depend on the operator. They are engineered into the tooling.

Investigate the savings of this process as applied to your operations. Get the whole story from a Red Ring engineer.



NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

For more data, circle this page number on inquiry card

NEW

proven design features . . .

Here is the second in the entirely new, field-tested line of heavy duty Nebel Lathes, extending Nebel economies even further into the heavy duty field.

The rugged, proven design Nebel Model 2516 Engine Lathe is built to the complete A.S.A. standards and tolerances of accuracy for engine lathes. It offers you more accuracy, more power, more and higher spindle speeds than ever before available from Nebel.

- Heavy duty 3-bearing spindle with zero precision bearings.
- 18 spindle speeds through complete gear range . . . up to 1500 RPM . . . streamlined speed selection.
- 60 feeds, 60 thread changes . . . all directly read.
- Automatic lubrication.
- Wide design carriage with 146 square inches of bearing surface on bed ways.
- Double-wall one piece totally enclosed apron with simplified controls.
- End gearing totally enclosed in self-lubricating housing.
- Power traverse heavy duty tailstock with rugged thrust lock.
- Rigid box girth design bed . . . hardened and ground steel bedways.

Write for new, fully descriptive Bulletin No. 213.

Nebel Lathe Division • Nebel Machine Tool Corp.
3410 Central Parkway, Cincinnati 25, Ohio

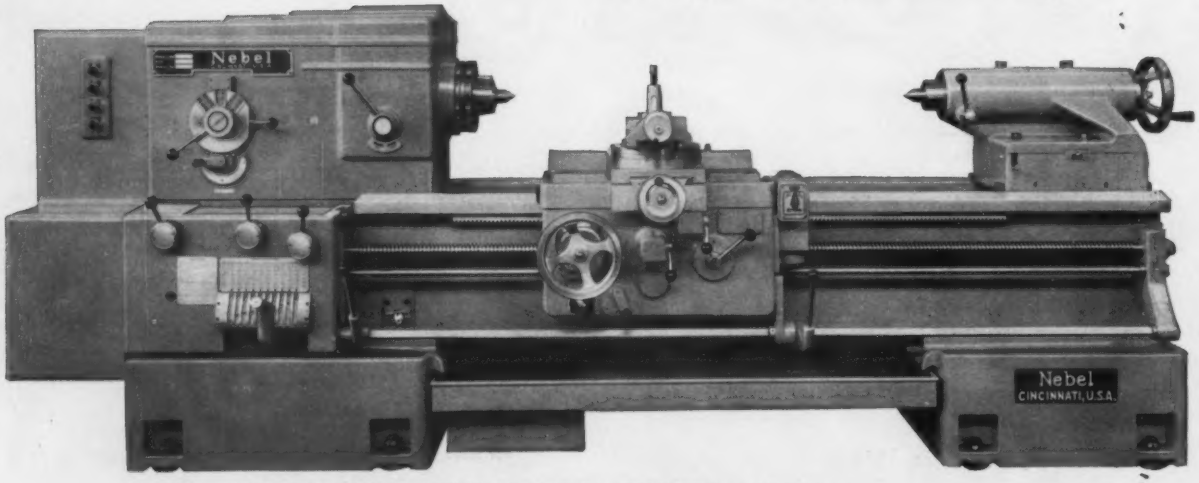
Other entirely new, proven design Nebel Lathes now available:

- Heavy Duty Model 2013 (Bulletin 212)
- Standard Duty Model 2516-20 (Bulletin 214)
- Heavy Duty Extension Bed Gap Lathe Model HXB 26/45 (Bulletin 211)

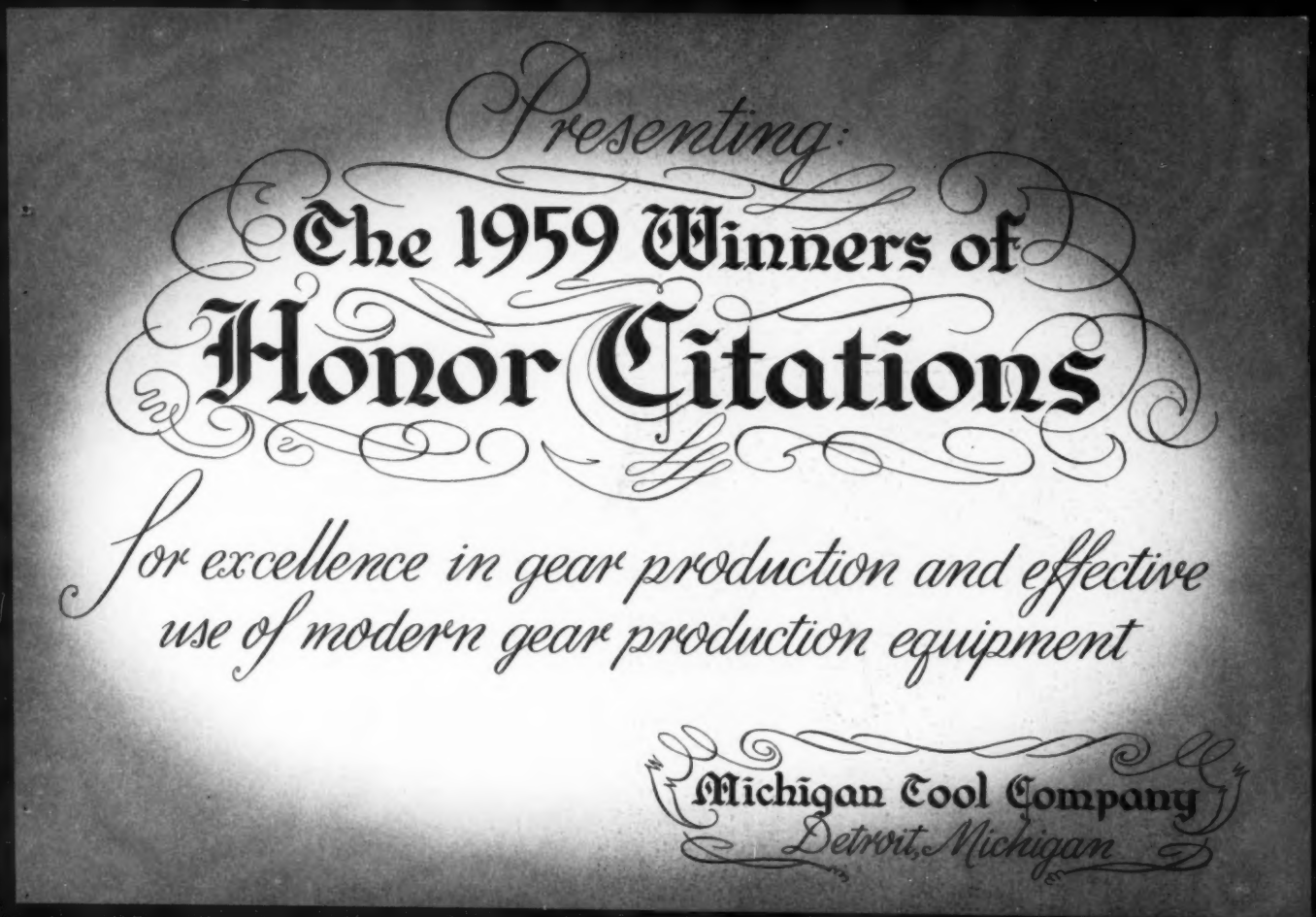
NēBEL

HEAVY DUTY ENGINE LATHE

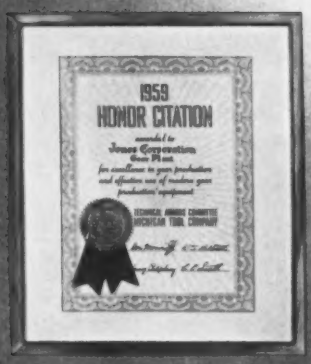
entirely new, proven design



NEBEL MODEL 2516 HEAVY DUTY ENGINE LATHE


Presenting:
The 1959 Winners of
Honor Citations
for excellence in gear production and effective
use of modern gear production equipment
Michigan Tool Company
Detroit, Michigan

How the Citations were awarded...



About two years ago, Michigan Tool Company set up — as part of its own research and development activities — a committee of engineers familiar with both the techniques and economics of gear production. Prime purpose of this committee was to help guide Michigan Tool's own research and development on new methods and equipment through detailed studies of the techniques and operations at individual plants.

About a year ago, it was decided to give public recognition to those cooperating companies in industry, the study of whose operations revealed valuable progress in gear production methods and uses of modern gear production equipment.

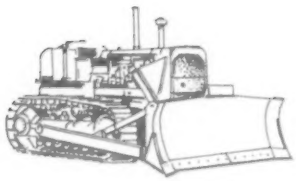
During the past year the operations of a number of plants were studied and several of these were named by the committee as qualifying for Honor Citations.

The studies are continuing. Several additional plants have already been recommended by the committee for Citations in the coming year while still others may qualify as studies of their operations are completed.

The individuals to receive the Citations in behalf of the plants were nominated by the managements of the recipient companies.

CATERPILLAR TRACTOR CO., Peoria Plant
W. L. Naumann, Plant Manager

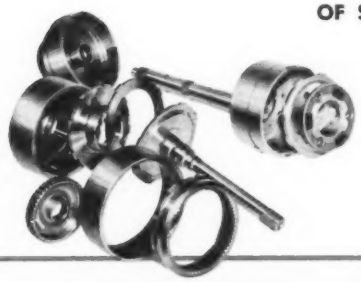
OF SPECIAL NOTE: Excellence in selection of tooling for production of heavy duty gearing to reduce costs and increase quality. Its extensive use of shaving to produce quiet gears of greater strength for road building and construction equipment was a factor in the selection of this plant for a citation.



Gordon Swardenski, Asst. Plant Mgr., left, receiving citation from M. R. Anderson, President, Michigan Tool Co. The machine in the background is an 873 finisher for heavy duty gears.

CHRYSLER CORPORATION, Kokomo, Ind. Plant
James Cypher, Plant Manager

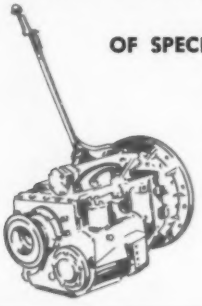
OF SPECIAL NOTE: The unique adaptation of the Shear-Speed gear-cutting process to the cutting of many types of tooth forms in a variety of materials — aluminum, steel, and cast iron.



James Cypher (right) receiving the 1959 Honor Award from M. R. Anderson, President of Michigan Tool Co. in front of one of the Shear-Speed gear cutting machines.

John H. Jones receiving the Honor Award from H. Pelphrey, Research Director, Michigan Tool Co.

DANA CORPORATION, Toledo Division
John H. Jones, Works Manager



OF SPECIAL NOTE: Its constant search for quality as evidenced by the quick adoption of abrasive gear finishing to improve the accuracy of hardened gears for heavy duty transmissions and eliminate any possible burrs and nicks resulting from handling of gears in process.

Michigan Abrasive Gear Finisher used to improve accuracy of hardened gears by Dana Corp.

C. E. Kopp (right) receiving the 1959 award in the motor boat engine field from Michigan Tool's president M. R. Anderson.

EVINRUDE MOTORS, Milwaukee
C. E. Kopp, Factory Manager

OF SPECIAL NOTE: Evinrude's vision in adapting chipless machining to the production of motor boat engines, particularly on stainless steel shafts — increasing strength of shafts and eliminating wastage of materials in the form of chips.

Rolling of involute teeth on Evinrude's stainless steel shafts on a Michigan Roto-Flo machine.

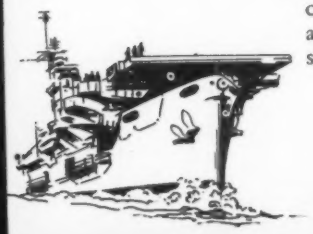
FORD MOTOR COMPANY, Transmission Division
R. L. McNulty, Plant Manager, Livonia

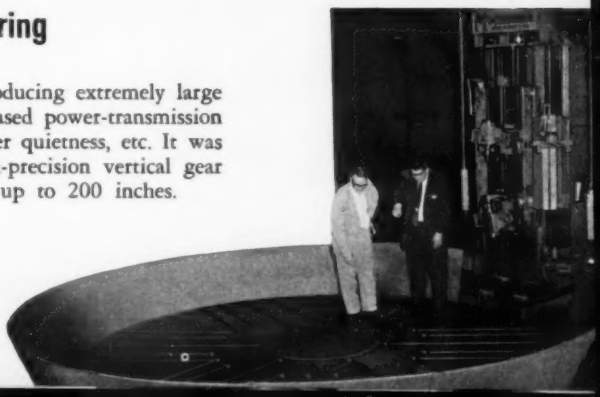
OF SPECIAL NOTE: The manner in which this plant has reduced the hazard of human errors in gear production through selection of high precision production equipment and mechanization of handling of gears in process as through the use of Gear-O-Mation in-process storage, feeding, unloading, orienting, and allied equipment.

Looking over some of the Gear-O-Mation equipment at Ford-Livonia are A. F. LeFevre, Quality Control Mgr; R. L. McNulty, Plant Manager; Stanley Cenzer, Mgr. of Mfg. Engrg; M. R. Anderson (President of Michigan Tool Co.) and E. M. Sirhal, Prod. Mgr.

GENERAL ELECTRIC COMPANY, River Works
Jasper E. Anderson, Manager of Manufacturing

OF SPECIAL NOTE: The outstanding job done in producing extremely large gearing for ship propulsion resulting in increased power-transmission capacity for a gear of a given size, far greater quietness, etc. It was also a pioneer in the use of very large high-precision vertical gear shavers (Michigan V-series) to finish gears up to 200 inches.



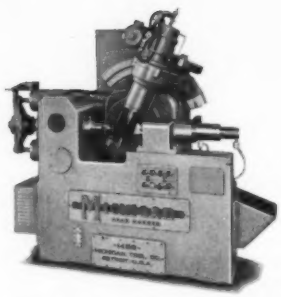


J. E. Anderson of G.E. and M. R. Anderson, President, Michigan Tool Co., standing on the table of one of G.E.'s huge Michigan V-series gear finishers—capable of producing highly accurate gears of up to 200" diameter.

INTERNATIONAL HARVESTER, Farmall Works
Paul Bohy, General Supt. Division 2
Ernest Palmer, General Foreman, Gear Lab.

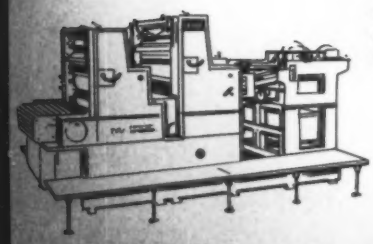
OF SPECIAL NOTE: Awarded the Citation in the tractor field, for the evidences of its constant search for equipment and methods which would reduce costs despite close tolerances. Example: Adaptation of high speed hobbing to the production of tractor gears.

(Left) Walter Rodger, Asst. Supt. and (right) Ernest Palmer, with A. D. F. Moncrieff, Michigan Tool VP who presented the awards.



A battery of Michigan 1458A high speed hobbers like this is used at the Farmall Works.

MILLER PRINTING MACHINERY COMPANY
Earl H. Sieg, Plant Manager

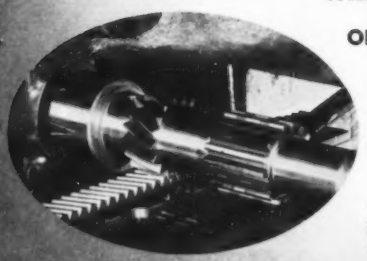


OF SPECIAL NOTE: The unusually tight tolerances which this manufacturer of offset printing machinery maintains on gears for offset printing equipment. Its constant checking for accuracy with the latest type of equipment.

Miller Printing Machinery officials looking over recordings of 100% involute checking of gears (on a Michigan Sine-Line 1124) (l. to r.) A. A. Saul, Chairman of the Board; R. S. Hildreth (Chief Engineer of Michigan Tool Co.); Earl Sieg, Plant Manager, and W. G. Young, President. Miller also uses a Michigan 1218A optical checker for gear leads.

ROCKWELL-STANDARD CORPORATION
Transmission and Axle Division, Newark, Ohio
Wm. E. St. Clair, General Manager

OF SPECIAL NOTE: Its continued search for gear production equipment which will result in higher quality gears at lower cost for its double reduction axles. Its use of "870" type gear shavers for a variety of gear sizes and types is an example.

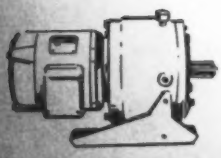


"Undercut" shaving at Rockwell-Standard on the Michigan 900 helps keep gears in mesh.

(R to L) H. E. Kraning, Asst. Gen. Mgr. and Wm. E. St. Clair, Gen. Mgr. of Rockwell-Standard with H. Pelphrey, Research Director of Michigan Tool Co. looking over an unusual shaving job on a Michigan 900.

WESTINGHOUSE ELECTRIC CORPORATION, Nuttall Works
F. D. Weatherholt, Division Manager, Gearing Div.

OF SPECIAL NOTE: This home of Moduline is believed to be the first to use chipless machining on gearmotor shafts, increasing uniformity, shaft strength and finish. Noteworthy are the close tolerances, extensive use of shaving, and precision checking to assure accurate gears both in job lots and in continuous runs.



R. S. Hildreth, Chief Engineer, Michigan Tool Co., discussing "optical lead checking" on a Michigan 1218A with Mr. Weatherholt, R. H. Timmons, Mfg. Mgr., and R. L. Mathias, Engrg. Manager, of Westinghouse Gearing Division, where production gears of master gear quality are the rule.

Products and Services of "Gear Production Headquarters"

LARGE EXPERIMENTAL LABORATORY for development and pilot runs of gears and geared components as well as tooling for customers.

GEAR CUTTING EQUIPMENT: "Michigan" and "Michigan-Lorenz" hobbers; "Michigan-Lorenz" gear shapers; "Shear-Speed" Gear Shapers; hobs, shaper cutters, involute cutters, etc.

GEAR FINISHING: "Michigan" gear shaving machines; "Michigan" gear lappers; "Michigan" abrasive gear finishers (for hardened gears); gear finishing cutters and tools.

GEAR CHECKING: "Sine-Line" gear checking equipment for laboratory and production line checking and analysis of gears; "Sine-Line" hob checking equipment; "Ultradex" split-second accuracy index tables; master gears.

AUTOMATION: "Gear-O-Mation" standard and custom-engineered equipment for handling of parts in process (storage, loading, unloading, conveying, orienting, distribution, etc.).

WORM GEARING: "Cone-Drive" double-enveloping worm gearing, speed reducers and gear motors.

CONSULTING SERVICE: On all phases of gear design, tool design, processing, equipment, automation and economics of gear production.

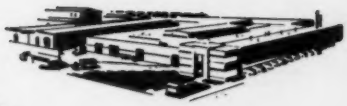
MICHIGAN TOOL Company

7171 E. McNICHOLS RD. • DETROIT 13, MICHIGAN, U. S. A.

PLANTS IN DETROIT, EAST DETROIT, MANISTEE (MICH.), TRAVERSE CITY (MICH.) AND WINDSOR (ONTARIO)

Field Engineers and Representatives in every important Industrial Center of the free world.

Another Interesting Statement by W. V. CASGRAIN, President, Mechanical Handling Systems Inc.

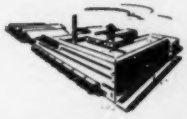


PLANT 1, DETROIT

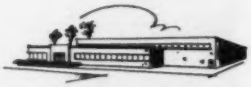
PLANT 2, DETROIT

ALBANY, N. Y.

WINDSOR, ONTARIO



FAIRFIELD, IOWA



CLARK, N. J.

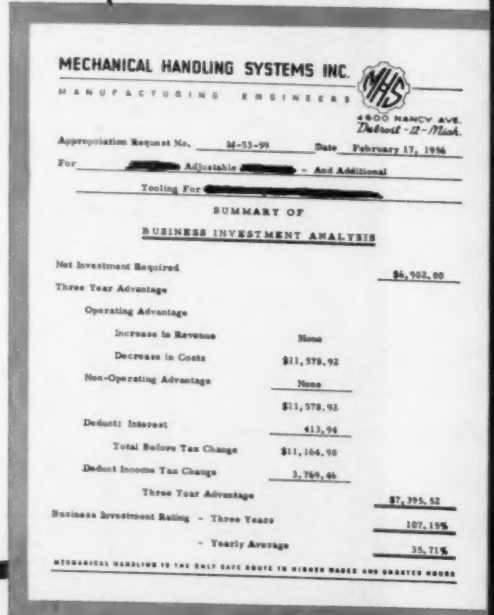
"AMONG Management's chief functions, and perhaps its most important, is the proper selection of investments for the most profitable application of capital. In the Manufacturing Industries money invested in modern tools usually provides a higher return than when invested in most securities and has greater built-in stability.

"We at Mechanical Handling Systems Inc. recognize this and encourage our several Production Departments in the search for improved tools and methods. Each proposed capital acquisition is submitted to Management on a "Request for Appropriation" form, and this is turned over to the Comptroller's Office for complete analysis, based very largely on the MAPI formula, but tailored to our own particular Company requirements.

"When the detailed analysis has been completed a "Summary of Business Investment analysis" form is made up, which summarizes the main points of the Analysis for consideration and decision by the Executive Committee.

"By use of this method we can make fair comparisons between the various propositions which constantly compete for available investment funds and select those which indicate the most economic returns. This applies equally to equipment recommended to replace wastage of assets or to meet new business conditions of competition or additional opportunity.

"The adoption of a planned program, not only for replacement but to meet anticipated obsolescence, must play a major role in all our Industries if we are to retain the vitality needed to continue our progress and Industrial expansion."



MECHANICAL HANDLING SYSTEMS INC.

MANUFACTURING ENGINEERS

4600 NANCY AVE. Detroit-12-Mich.

Appropriation Request No. M-53-99 Date February 17, 1956

For [redacted] Adjustable [redacted] - And Additional

Tooling For [redacted]

SUMMARY OF

BUSINESS INVESTMENT ANALYSIS

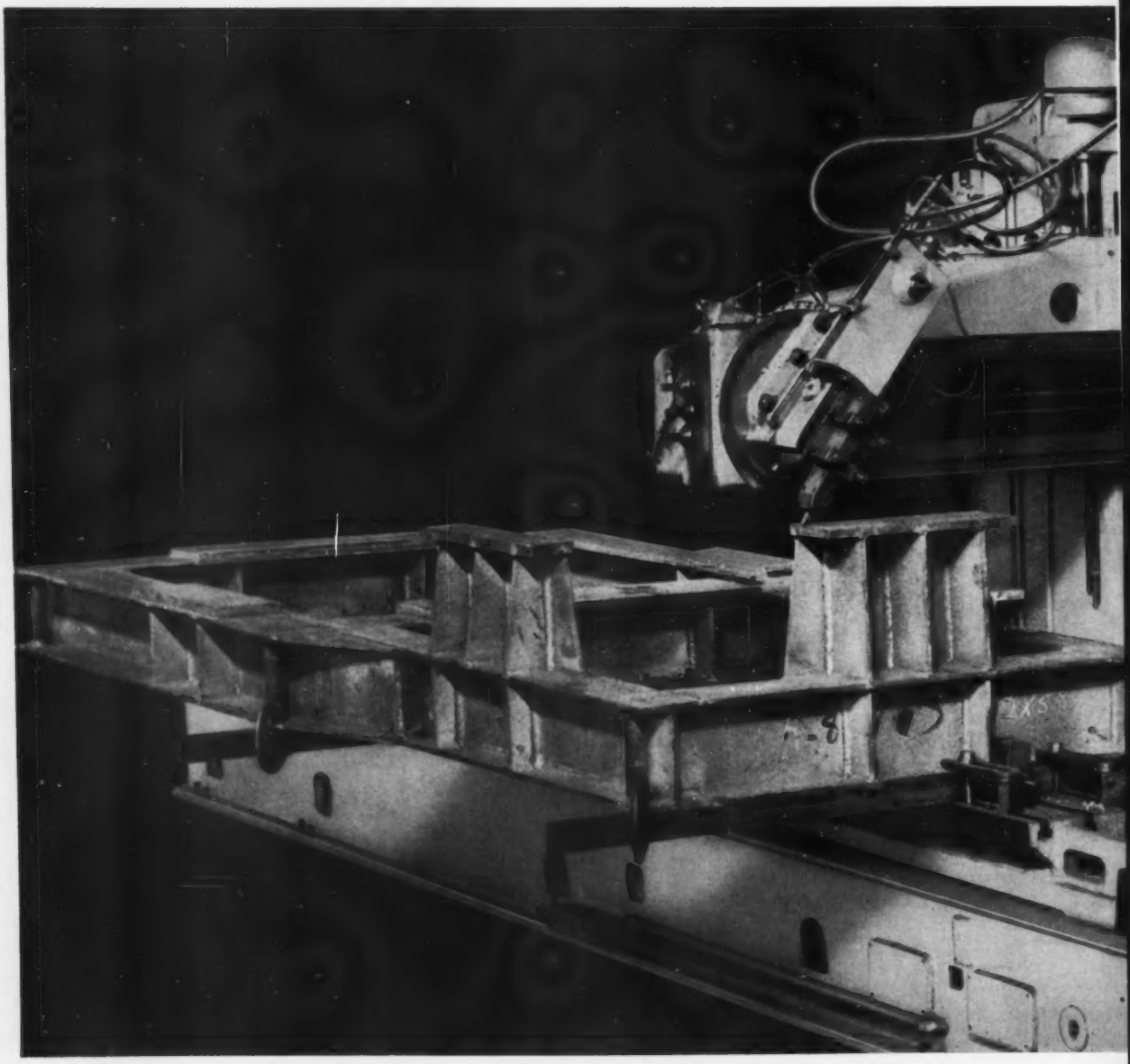
Net Investment Required		$6,902.00
Three Year Advantage		
Operating Advantage		
Increase in Revenue	None	
Decrease in Costs	$11,578.92	
Non-Operating Advantage	None	
	$11,578.92	
Deduct: Interest	413.94	
Total Before Tax Change	$11,164.98	
Deduct Income Tax Change	3,769.46	
Three Year Advantage		$7,395.52
Business Investment Rating - Three Years		107.19%
- Yearly Average		35.71%

MECHANICAL HANDLING IS THE DAILY DATE ROUTE TO HIGHER WAGES AND GREATER HOURS

KEEP GATHERING METAL WORKING PRODUCTION IDEAS . . . BE WELL INFORMED WHEN YOU REPLACE MACHINERY

ROCKFORD INSERT GROUP

Nothing does the job like a...

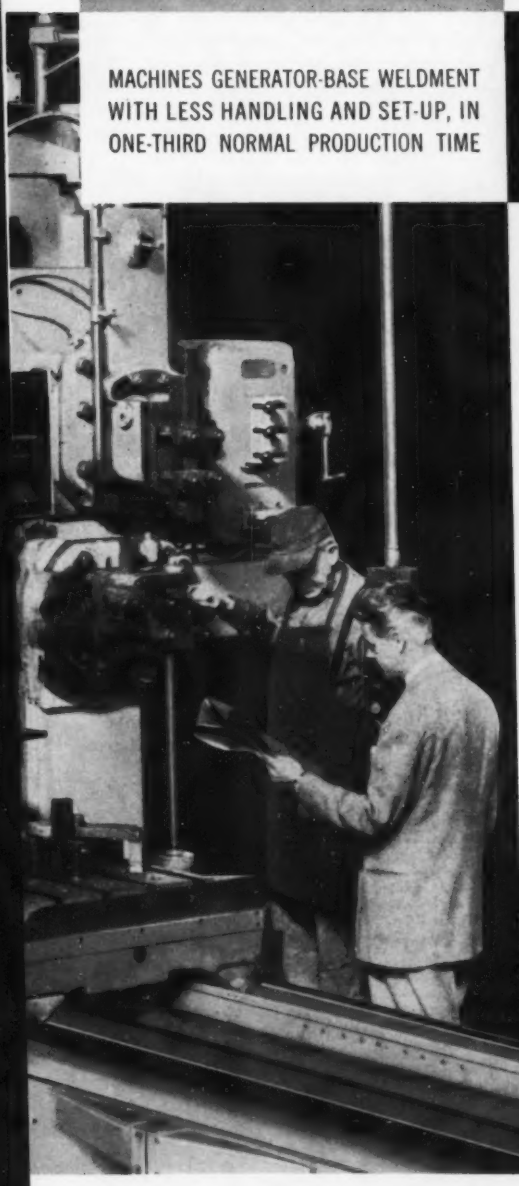


CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

ROCKFORD

HYDRAULIC PLANER

MACHINES GENERATOR-BASE WELDMENT WITH LESS HANDLING AND SET-UP, IN ONE-THIRD NORMAL PRODUCTION TIME



Machining data:

Dimensions Weldment ..... 8'7" wide
.....15'3" long

Weight Workpiece .....5400 lbs.

Operation:
Planing top-side pads, highest pad 30½" from base of work.

Set-Up Time .....1st set-up, 1¼ hrs.,
.....2nd set-up, 1½ hrs.,
includes surface indication for continuation of cut.

Machining Time .....17¾ hrs.

Nothing performs like hydraulic power:

- Infinitely adjustable feeds and speeds;
- Smooth, uniform cutting pressures for finer finish;
- Maximum metal removal per H.P. expended;
- Low Costs for machining, cutting tools and maintenance.

ROCKFORD MACHINE TOOL CO.
2500 KISHWAUKEE STREET • ROCKFORD, ILLINOIS

Pioneers In The Use of Hydraulic Power for Reciprocating Machine Tools

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

Carl:
This sounds like what we've been looking for. Suggest you investigate
JE

COOPERATIVE CREATIVE-ENGINEERING

• COOPERATION IN IDEAS

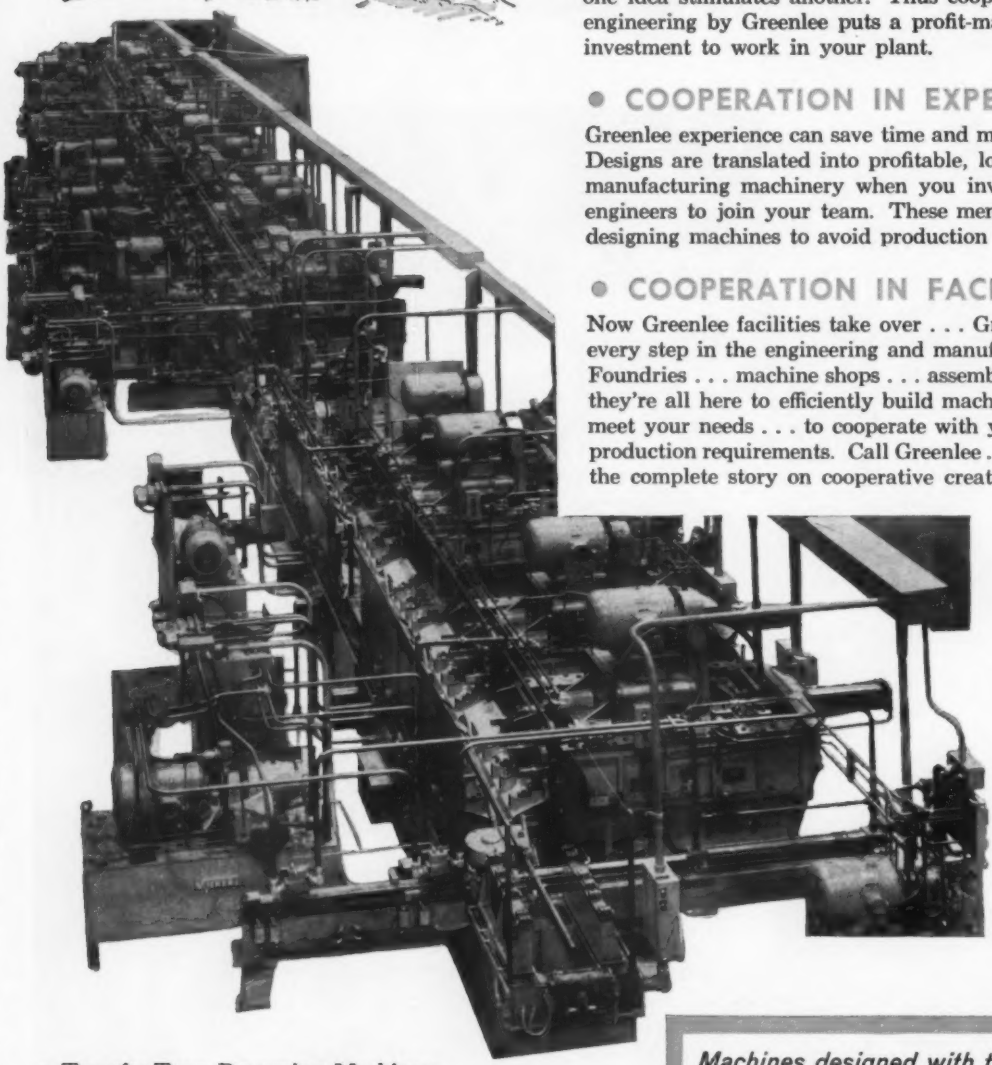
Greenlee engineers work with your men at all levels of management, production, and engineering. They gather and exchange information based on broad experience. These contacts accelerate creative thinking . . . one idea stimulates another. Thus cooperative creative-engineering by Greenlee puts a profit-making investment to work in your plant.

• COOPERATION IN EXPERIENCE

Greenlee experience can save time and money in your plant. Designs are translated into profitable, low-cost manufacturing machinery when you invite Greenlee engineers to join your team. These men know the art of designing machines to avoid production problems.

• COOPERATION IN FACILITIES

Now Greenlee facilities take over . . . Greenlee controls every step in the engineering and manufacture of machines. Foundries . . . machine shops . . . assembly floors . . . they're all here to efficiently build machines to meet your needs . . . to cooperate with you in meeting production requirements. Call Greenlee . . . let them give you the complete story on cooperative creative-engineering.



PRODUCTION MACHINERY
GREENLEE

Miss Jones:
write for available literature and mail this to Joe Thompson
C.F.

- Transfer-Type Processing Machines
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines and Trim Presses
- Hydro-Borer Precision Boring Units
- Core Box Handling Equipment for Foundries
- Specialized Woodworking Machines
- Hand Tools for Woodworking
- Tools for Woodworking Machines
- Hydraulic Tools for Electricians, Plumbers, Contractors

Machines designed with the future in mind

GREENLEE
BROS. & CO.
1747 MASON AVE.
ROCKFORD, ILLINOIS

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

New Quick-Tilt spindle can increase your grinder production 50%

Converts from roughing to finishing in seconds

Until now, users of vertical-spindle surface grinders have had to compromise either accuracy or production because of the difficulty in tilting the wheel spindle. In fact, to combine high stock removal with fine finish and flatness meant paying for two operations instead of one.

Now it is possible to tilt the spindle by just turning a selector switch. You have power-tilting to eliminate wheel drag when roughing, yet in a matter of seconds the grinding wheel can be reset to the flat position for finish grinding.

Simple, isn't it? You might even ask: "Why didn't you think of this ten years ago?" Actually, the real significance of this feature lies in the new thinking about surface grinding as a stock removal operation. Ten years ago grinding was considered a finishing process. Therefore, it was not until we had proved the direct and indirect cost savings made possible by grinding from the rough that the need for power-tilting spindles became imperative.

Production tests in our Methods Laboratory show that the average grinding operation can be at least 50% more efficient—that's comparing one machine with the wheel set flat against one on which the cycle is divided between roughing and finishing. But, the profit significance of power-tilting shows up more dramatically when *grinding* through outer scale and burned edges instead of milling or planing.

How to increase stock removal

With a tilted spindle your motor horsepower is applied over a smaller wheel area for greater grain penetration. This produces a bigger chip. You can use harder wheels and still get breakdown.

Fig. 1—Turning the selector switch automatically tilts the spindle .010 in. toward the leading edge, or back to dead flat.

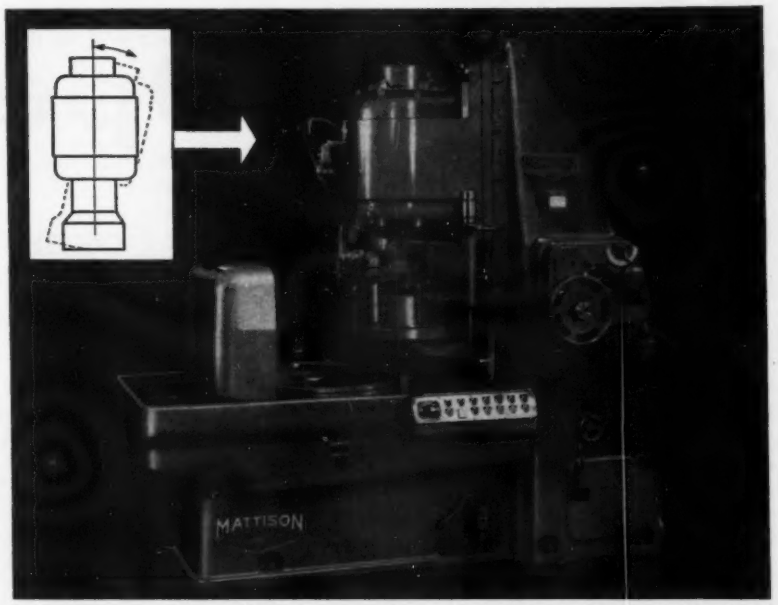


Fig. 2—Quick-Tilt spindles solidify all the accuracy and stock removal features built into Mattison No. 24 and 36 rotaries. These machines are being built with spindle motors up to 60 hp to provide optimum cutting speeds on stock-removal operations.

With modern casting and forging techniques, there is no reason why stock allowances should not be specified for rough grinding of flat surfaces. This means a saving of approximately 50% of the stock allowance normally required for tool or cutter finishing. If close tolerances or finish are requirements, think of the dual advantages by grinding.

Hard spots, scale, and burned edges are no problem. We can show you examples of savings on parts such as bolster plates, forging dies, pump castings, and forged steel chain links.

Increases accuracy of small parts

With the practical elimination of curvature during the finish grind, more small parts can be ground per table load and setups can be speeded because the work need not be centered in relation to the wheel "ellipse." You use the same, easily adjusted clearance for every job. Leave enough stock for finishing and it is possible to grind over the full diameter of the wheel and still hold precision tolerances on all parts whether they're located at the outer edge or under the low point.

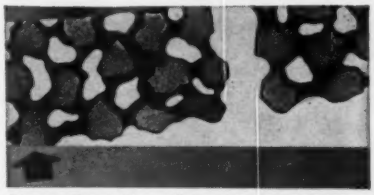


Fig. 3—Tilting the spindle reduces contact area between segments and work, permits use of higher horsepower and harder wheels. Slight bevel at leading edge reduces contact area for finishing.

See a demonstration

We are producing perfect diamond finishes on parts having large, uninterrupted surfaces. We can show you production savings, wheel life, and accuracy on test jobs or your own. Your Mattison dealer will make all the arrangements.

MATTISON MACHINE WORKS
Rockford, Illinois Phone 2-5521

Want more information? Send for new catalog describing Quick-Tilt spindle and other exclusive features of Mattison's Nos. 24 and 36 vertical rotary.

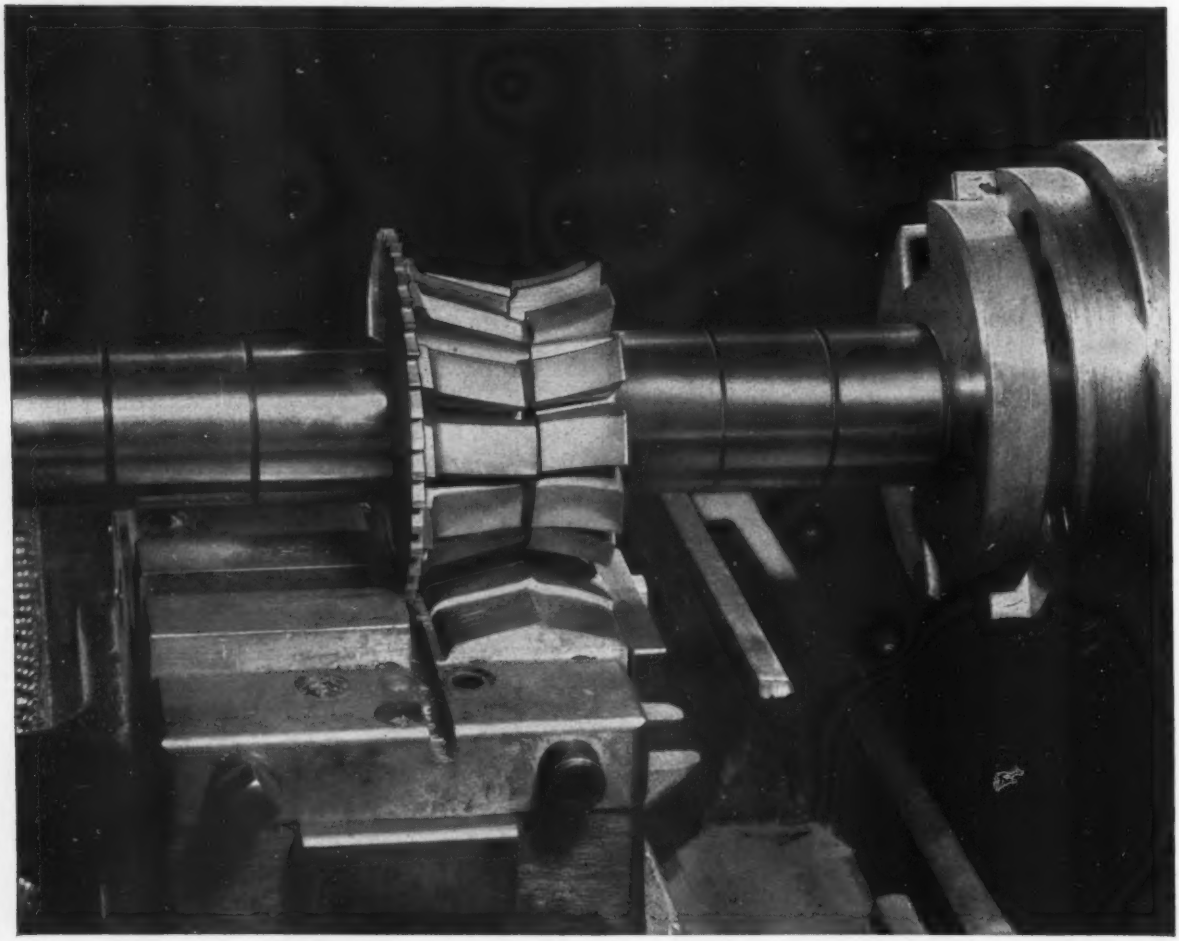
MATTISON MACHINE WORKS

HIGH-POWERED PRECISION SURFACE GRINDERS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

Mill Odd Shapes in One Operation

...with Barber-Colman Form-Relieved Cutters



MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

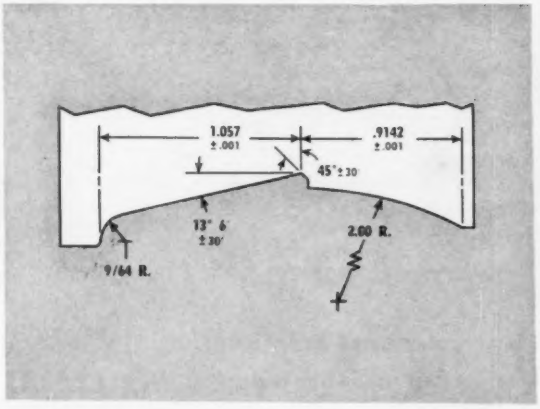
Milling is the best way to produce accurate, irregular forms with a minimum of tooling expense. But, when you get down to cases, much depends on the design and quality of the milling cutter used.

Barber-Colman Company will manufacture a cutter from your part or print for almost any form. In it will be designed all the factors needed to upgrade production efficiency and work quality.

Take this small part, for example. As shown on the drawing, there are two opposed surfaces that require machining at right angles to the cutter axis. For efficient milling at these points, the teeth must have both left-hand and right-hand axial relief. This design problem was solved by making the tool interlocking, with axial relief in both directions. Right-hand and left-hand helical flutes assure smooth cutting action and fine finish.

The cutters are *unground*. Yet, all dimensions are held to a maximum tolerance of ± .002 in. Angular surfaces are held to ± 30 minutes. A separate cutoff operation was eliminated by ganging a metal-slitting saw with the form cutters.

Thus, fine finish and high accuracy were provided at the lowest possible cost and with a minimum tooling expense.



Five types of engineering . . .

These Barber-Colman engineering and manufacturing capabilities can be added to your own in finding better solutions to milling problems:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.

2. *Design engineering* — highly specialized tool engineering, backed by electronic computers for fast, accurate calculation of complex tooth forms.

3. *Metallurgical engineering* — specially selected steels and heat treatment for your particular material and tool geometry.

4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and any cutter style.

5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

If you are producing irregular parts by shaping, crush grinding, or milling, it will pay you to let a Barber-Colman milling cutter engineer look at the job. He will show you how to combine the maximum number of operations in a single cut with lowest possible tool cost. Call your Barber-Colman sales office or Rockford — TR - 7-5741.

Barber-Colman Company

BARBER COLMAN

112 Loomis St. Rockford, Illinois

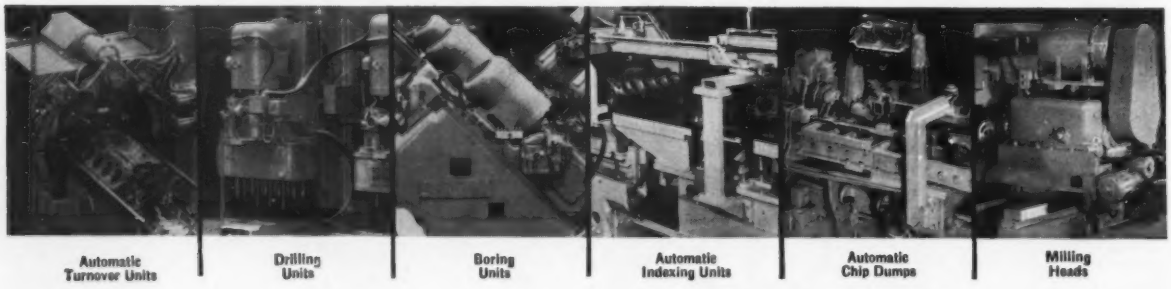
FOR PRODUCTION MACHINE TOOLS IT'S ROCKFORD, ILLINOIS, U.S.A.

SUNDSTRAND *"Engineered Production"* NEWS

For economical, volume production of parts like these...

Get your best machine buy after a Sundstrand *"Engineered Production Analysis"*

Whether the job calls for milling, turning, boring, drilling, or any combination of these and any other operations, a Sundstrand "Engineered Production" analysis assures the most efficient processing method. Standard components like those shown below reduce original investment.



Automatic Turnover Units | Drilling Units | Boring Units | Automatic Indexing Units | Automatic Chip Dumps | Milling Heads

"Engineered Production" Service

SUNDSTRAND

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

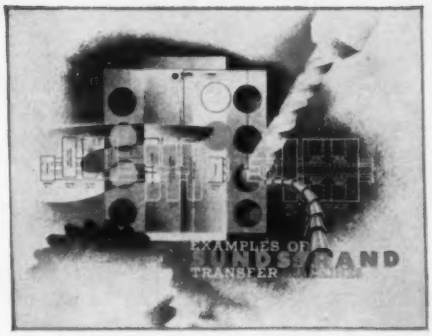
Sundstrand solutions include many years of experience with all three basic types of process machines: (1) *Work transfer* where work progresses from one station to the next and is located in another fixture, (2) *pallet type* where work and fixture move together, and (3) *indexing or dial type* consisting of an indexing rotary table and enough machining stations for the required operations.

Factors considered as part of a Sundstrand "Engineered Production" analysis that determine the best type of machine for the job include: Hourly and total production required, shape of the part, material composition, required locating points, and numerous related factors.

Broad use of standard components in designing special machines provides two outstanding benefits: (1) Lower initial capital equipment outlays and (2) simpler, lower cost modification when change occurs in parts being processed.

Processing lines built by Sundstrand offer from less than 10 to more than 40 separate work stations with multiple operations being performed at many stations. Brief descriptions of these typical solutions are contained in a booklet available from Sundstrand. Parts being processed include cylinder blocks, crankshafts, camshafts, electric motor frames, transmission housings, and brake drums.

For more details on how Sundstrand applies "Engineered Production" solutions to insure the best machining method write for Bulletin 609.



HERE ARE TYPICAL SUNDSTRAND SOLUTIONS

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

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More facts about

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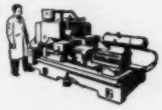
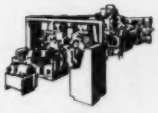
"Engineered Production"

Literature listed under various machine types has more details. Write Sundstrand for your copy today.

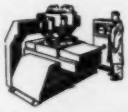


Automatic and Tracer Lathes
Bulletin A-109

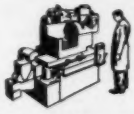
Engineered Milling Production
Bulletin B-109



Examples of Transfer Machines—Bulletin C-109



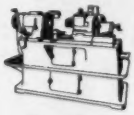
Multiple-spindle Drilling Machines—Bulletin D-109



Internal and Rotary Surface Grinders—Bulletin E-109

Broaching Tools
Bulletin F-109

Practical Broaching Methods
Bulletin F-109



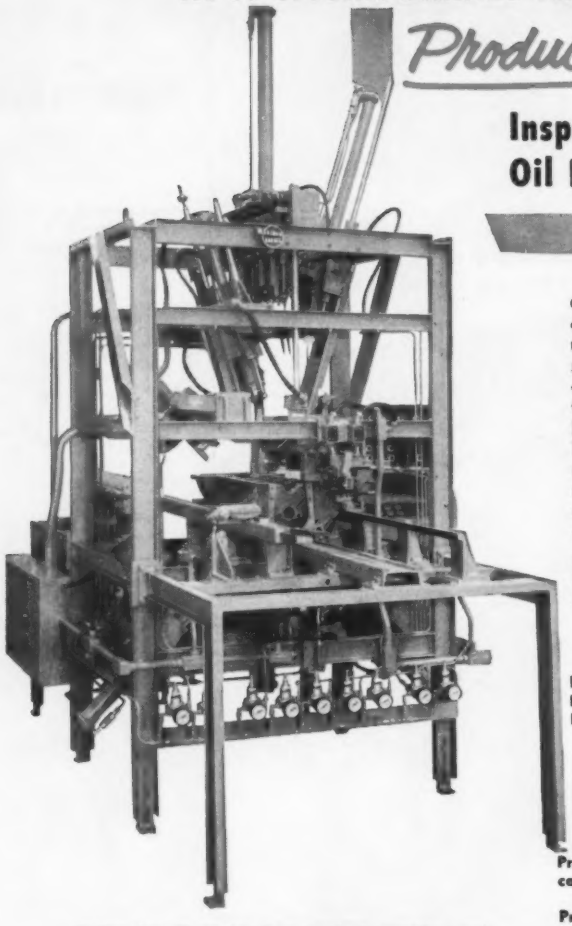
Thread Milling
Bulletin G-109

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

SPECIAL

W. F. & JOHN BARNES MACHINE *Solves Production Line Problem*

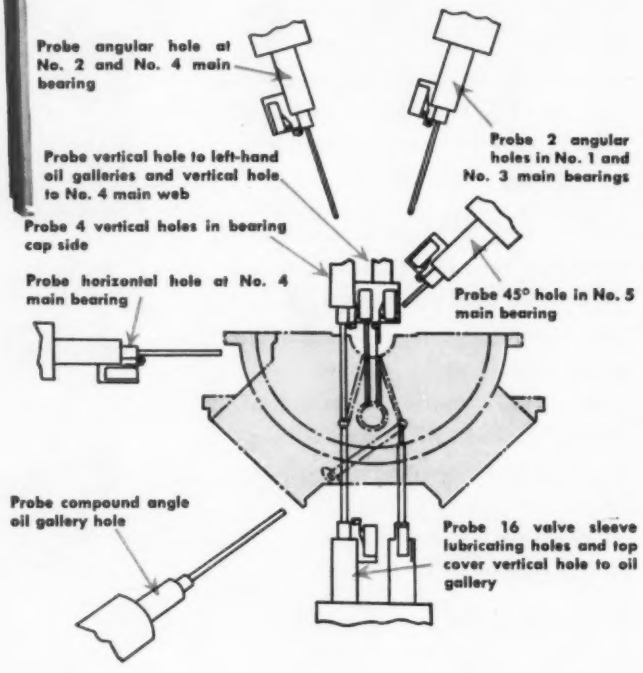
Inspects 36 Cylinder Block Oil Holes Automatically



▶ Drawing illustrates how vertical, angular, and horizontal air cylinders automatically probe 36 cylinder block oil holes. Collapsing-type probes indicate the exact obstructed oil hole on a master control panel.

● This W. F. & John Barnes Special Automatic Probe Machine, designed and built for a large automobile manufacturer, now test probes 36 cylinder block oil holes for obstructions automatically. The new unit is located in the cylinder block production line just ahead of a bearing cap assembly station. Collapsing-type probes, equipped with microswitches, indicate location of any obstructed holes on a master control panel. Faulty blocks are marked for removal from the Barnes machine and are not allowed to proceed to the next station until the operator clears the master control panel.

This machine is just one of many types designed and built by W. F. & John Barnes to help solve troublesome production problems. Call in a Barnes Process Equipment Engineer today. He'll work with you in developing better cost-cutting methods and equipment.


Probe angular hole at No. 2 and No. 4 main bearing
Probe 2 angular holes in No. 1 and No. 3 main bearings
Probe vertical hole to left-hand oil galleries and vertical hole to No. 4 main web
Probe 4 vertical holes in bearing cap side
Probe horizontal hole at No. 4 main bearing
Probe 45° hole in No. 5 main bearing
Probe compound angle oil gallery hole
Probe 16 valve sleeve lubricating holes and top cover vertical hole to oil gallery

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Write today for your copy of "Coordinated Machine Engineering" describing modern machines and mass production techniques.

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Special Machine Tools | Special Handling Equipment | Special Electrical Controls

W. F. & JOHN BARNES COMPANY

PROCESS EQUIPMENT DIVISION

416 SOUTH WATER STREET • ROCKFORD, ILLINOIS

BUILDERS OF BETTER MACHINES AND EQUIPMENT SINCE 1872

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

As he cuts off steel... he adds the "Touch of Gold"

The cut-off wheel this man is using is one of the complete Norton line, developed to bring the value-adding "Touch of Gold" to all cutting-off jobs, on all metals and the widest variety of non-metallic materials.

For wet or dry cutting, on manual or automatic machines, Norton cut-off wheels are available in ALUNDUM* aluminum oxide and CRYSTOLON* silicon carbide abrasives . . . in resinoid, rubber and shellac bonds . . . with or without reinforcement of glass cloth, nylon, cotton or combinations of these.

Backed by leadership in abrasive product development, Norton cut-off wheels are recognized as the most efficient, most economical production tools of their type. Your Norton Man, a trained Abrasive Engineer, and your Norton Distributor will be glad to tell you how these "Touch of Gold" benefits can be brought to your own production. NORTON COMPANY, General Offices, Worcester 6, Mass.

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ABRASIVES

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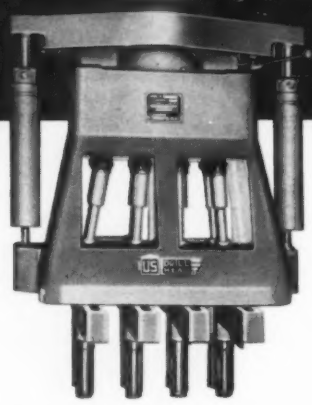
Complete DRILLING

versatility

for the "cumbersome" parts... with U. S. DRILL HEADS



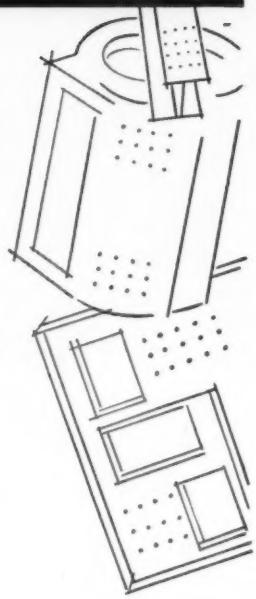
- ☐ Full ball bearing mounting of shafts
- ☐ Shaved gears throughout
- ☐ Exclusive quick-change neoprene-sealed universal joints
- ☐ Heavy duty spindle assemblies
- ☐ Adjustable-arm spindle mounts, or special bored Slip Spindle Plates
- ☐ Oil-tight, high-strength cast housings

Is your drilling *accurate and economical* in structural steel, tube sheets, flue sheets, and other large, cumbersome parts? It will pay you to check into a U. S. Drill Head installation on your radial drill!

Style U Universal Joint Adjustable Heads equipped with Air Counterbalance and 360° Ball Bearing Swivel Attachment give added versatility to any radial drill. Quick setup with positive lock of swivel in aligned position. Fast and accurate operation with minimum operator fatigue.

Select the *right* head for your jobs from the many sizes of Style U Heads. You'll get lots of cost-reducing features.

Write for descriptive literature, or ask for recommendations on your particular multiple drilling problems.



US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

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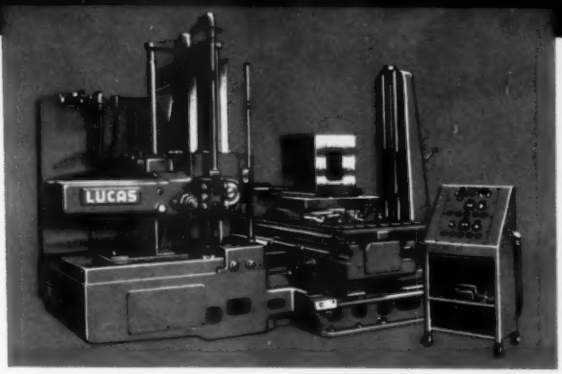
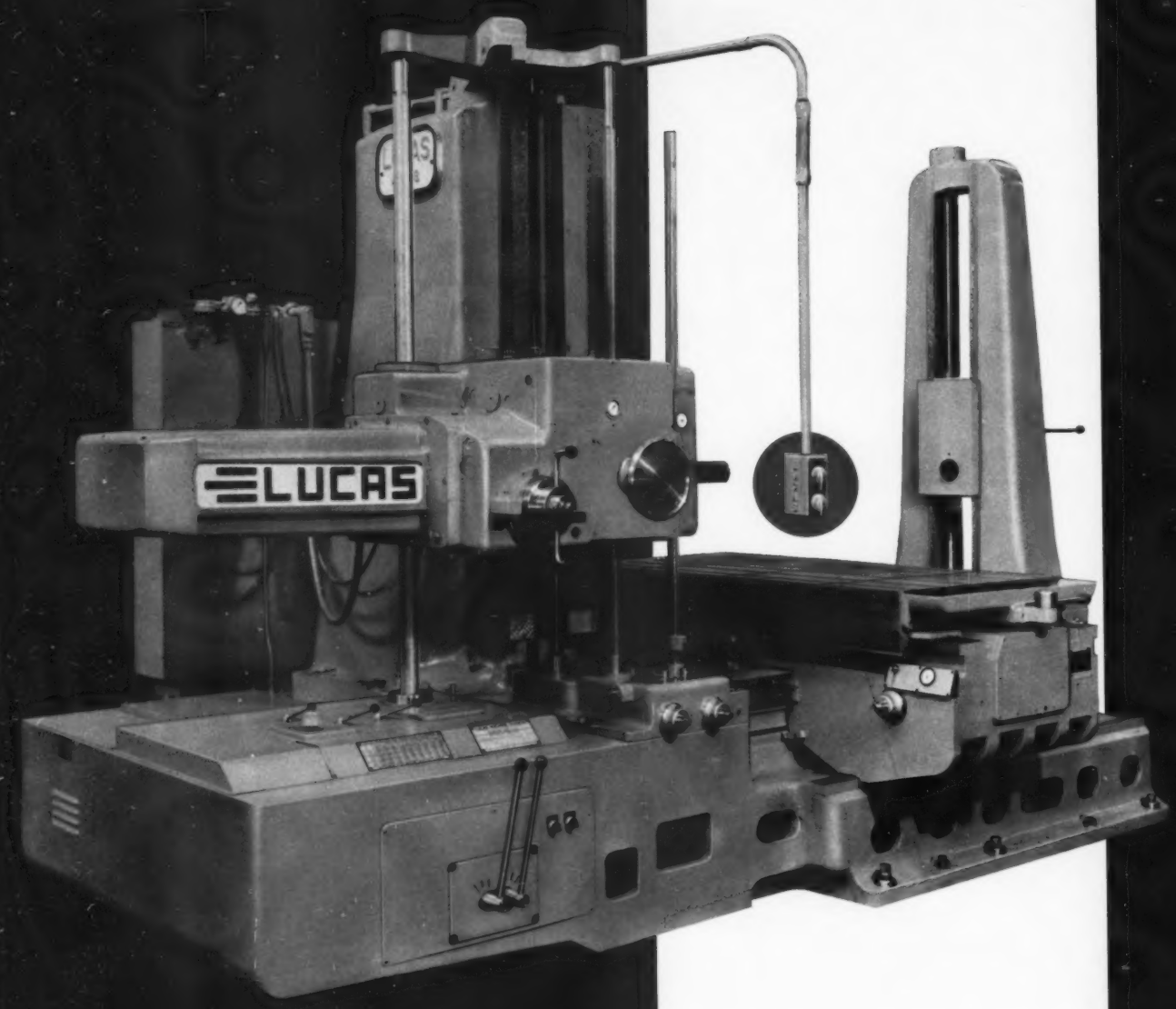
Tape control... certainly!

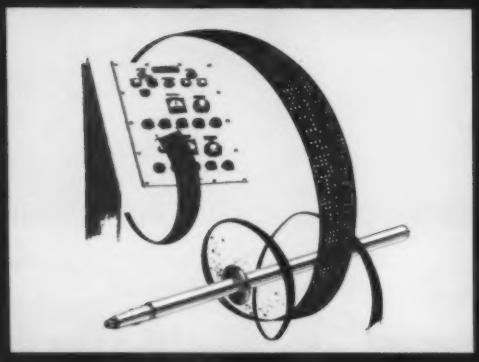
Tape control can readily be applied to any Lucas model, (2 3/4" to 6" diameter spindles) if repetitive operations or complicated one-of-a-kind jobs make this new development advantageous. Lucas tape controlled machines are available with punched tape for N.P.C., magnetic tape for contouring, or tape and tracer control. If you have a profitable use for *any* type or size of horizontal boring, drilling and milling machine (up to 6" spindle capacity) you can get it at its best from the specialist in this type of machine. *Did you ever meet a man who regretted picking a Lucas?*



LUCAS
OF CLEVELAND



Simplified pendant controls . . .



A Lucas performs the greatest variety of operations possible in any machine tool. Standard models permit control of *all* operations from the pendant. Optional pendant and lever control machines, like the one shown above, combine a simplified pendant with readily accessible levers. Whichever type of control you want—pendant, lever, tape, tracer or any of these in combination —Lucas has it.

LUCAS
OF CLEVELAND

here comes real detergency

Stuart's new Hi-D

transparent metalworking compound

Stuart

Hybrid compound keeps grinding wheels open and free-cutting, minimizes machine tool maintenance.

Now, today, there is a metalworking compound that offers extra-high detergency for stress-free grinding, yet does not attack paint, remove way lubricant, or leave crystalline deposits on the machine . . . that lubricates as it cleans, yet does not leave an oil film on the chuck . . . that is just as clear as any synthetic compound, yet is a petrochemical-type solution that is effective and stable at 60:1.

Hi-D is one of the outstanding lubrication developments in Stuart's 90-year history. Yet, it costs less per drum than most "coolants"—up to ⅓ less at proper dilution than some high-priced cutting fluids.

No other cutting and grinding compound is anything like it. Best described as a hybrid, it has all the qualities you look for in a synthetic without any of the disadvantages.

Who uses it? Turn the page and read results being obtained

Stuart

Productive Lubrication

FOR PROFIT-MINDED PRODUCTION MEN

VOL. 1, NO. 4 NOVEMBER-DECEMBER 1959

Stuart's HI-D checks rust, reduces costs at La Salle Steel

Stuart's new high-detergency, wide-purpose chemical compound—HI-D—proved to be just what the people at La Salle Steel Company wanted: a cutting fluid that works equally well for grinding or turning, and is capable of inhibiting rust at economically lean mixtures.

During its preliminary evaluation, Stuart's HI-D was put on two Medart turners. We're happy to report (having more than a passing interest in this product) that it made a versatile showing and was immediately put to work on 9 machines in the grinding and turning department. Jobs ranged from roughing cuts of 1/16" to 1/4" on the turners to lighter cuts for accuracy and fine finish on the grinding machines. Which brings up one of the ticklish problems at La Salle . . . in-plant protection for highly finished steel bar stock.

In testing other lubricants, La Salle found bars rusted too readily at dilutions of 30:1. But Stuart's HI-D worked efficiently at a 50:1 dilution while it held its high detergency and lubricity potency for efficient turning and grinding. La Salle maintained quality and at the same time reduced cutting fluid costs plenty (45%).

Stuart's HI-D can be used at 50:1 on machines like this centerless grinder as compared with 15:1 for the previous compound.

If you're looking for a cutting compound that combines high detergency, rust prevention, wide job range, high cooling capacity, and excellent lubricity, it will pay you to call in a Stuart representative. Our real objective is even more direct — buy a drum of Stuart's HI-D and test it on your problem jobs.

Phone your Stuart Representative listed at right.

Stuart

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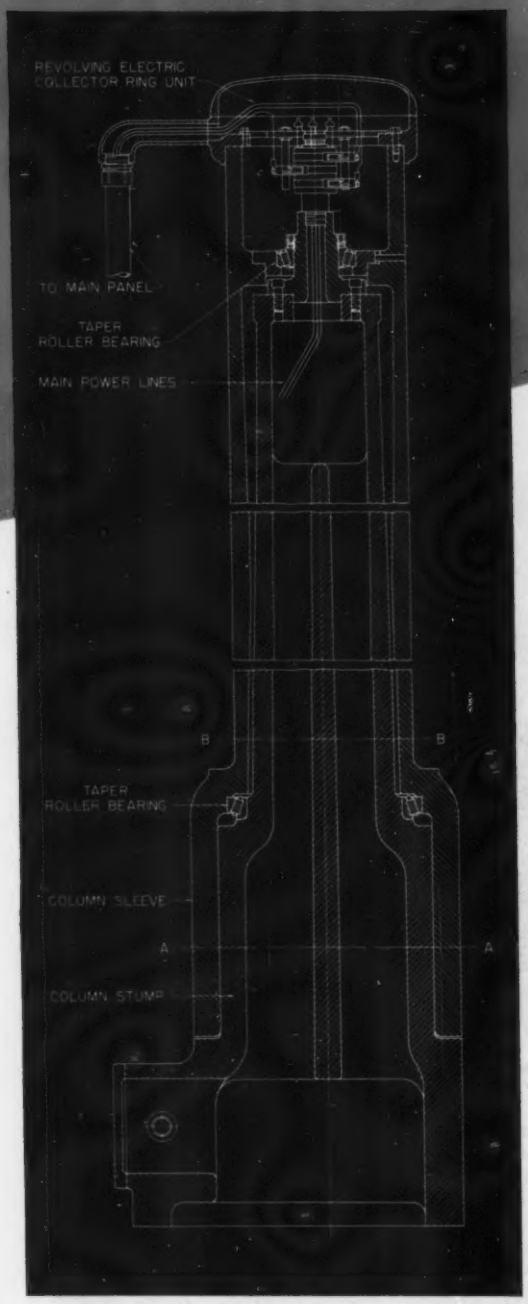
Rigidity Increased

50%



New thrust resistant, "TIMKEN" mounted column and sleeve assembly.

The new "TIMKEN" mounting of the column and sleeve on the new model 32-speed Hole Wizard Radial has hit the "jack-pot" for rigidity. It's the stiffest, most resistant column unit we've ever known.

Under drilling tests up to 30 horse power deflection has been cut in half over former models. It's truly a marvel of rigidity.

Large Timken bearings at top and bottom when preloaded bind the column and sleeve into the equivalent of a solid unit for resisting functional stresses and cuts arm deflection to an absolute minimum. This definitely results in greater accuracy and longer cutting tool life. To further increase resistance to stresses the column sleeve departs from conventional design by employing a tapered inner wall providing an unusually heavy section where the greatest functional stresses are concentrated.

A new "NON-CREEP" clamping mechanism in combination with a solid column sleeve cuff adds greatly to the rigidity of this new "AMERICAN" Radial.

Write for Bulletin No. 328 **for the complete story of More and Better Work at Lower Cost.**

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

3 OR 30,000 PIECES

Cut them off MORE ACCURATELY at LOWER COST and FASTER on a MARVEL Hack Saw

1. Accuracy? 2. Speed? 3. Low Cost?

Which is most important in your production or intermittent cutting-off operations? *You get all 3* when your work is handled on a MARVEL Series 6A or 9A Heavy Duty Ball Bearing Hack Saw. Whether you're cutting 3 or 30,000 identical pieces, you can be certain that each piece will be true . . . that it will be cut-off quickly, and at the lowest possible tool cost.

MARVEL Hack Saws are fine machine tools, with all the built-in accuracy this description implies. Designed to operate at higher speeds, with the heaviest feed pressures, they have almost unlimited power and stamina to stand up to the most severe service.

MARVEL Hack Saws are truly multi-purpose cutting-off machines. *No* run is too short or too long, *no* material too mild or too tough to be accurately and efficiently cut-off on a MARVEL Hack Saw.

Catalog C85 has complete details, facts and figures on both Marvel metal cutting Hack Saws and Band Saws. Write for it today.

S-1306

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MARVEL Metal Cutting SAWS
Better Machines–Better Blades

DRILLING HIGH TEMPERATURE ALLOYS WITH THE "BUFFALO" RPMSTER

In 1953, this "Buffalo" RPMster was installed in General Electric Company Jet Engine Department's Metal Working Laboratory. Since that time it has operated for thousands of hours, drilling high temperature alloys such as A-286, U-500, Rene-41, M-252, L-605, X-40, chrom-alloy and many other difficult materials.

In conjunction with dynamometers to record drill thrust and torque, many drilling problems have been solved. The "Buffalo" RPMster was ideally suited to this job because of its instantly available range of speeds from 90 to 3000 RPM and rigid construction. While General Electric uses the drill for testing purposes, new improvements make the "Buffalo" RPMster even more desirable as a production or special application drilling machine. A new torque controlled power feed prevents damage to machine and tool being used and capacities up to 2″ are now offered. Of special interest to companies drilling super-hard materials is the modified RPMster supplied with balanced hollow spindle, forced coolant system having a pump with a capacity to 100 psi, special splash guards and rubber-flex collet chuck. This machine is designed to operate with the new hollow core "cold point" drill, and diamond impregnated bits. "Buffalo" hollow spindle drills are available for speeds up to 10,000 RPM.

For further information on the "Buffalo" Variable Speed RPMster, contact your machine tool dealer or write direct for details.

BUFFALO FORGE COMPANY "Buffalo" ESTABLISHED 1877 MEMBER N.M.T.B.A. **440 BROADWAY • BUFFALO, N. Y.**

CANADIAN BLOWER & FORGE CO., LTD., KITCHENER, ONTARIO

DRILLING • PUNCHING • SHEARING • BENDING

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ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS

CLEANING DIES? Strip them bare in a single solution—OAKITE RUSTRIPPER

If it's a maintenance cleaning job, make it a part of a planned program. Take cleaning prior to reconditioning dies and tools, for example. An Oakite Planned Maintenance Program suggests how to get it done at the lowest possible unit cost.

First, tools and dies are simply soaked in Oakite RUSTRIPPER. In just a few minutes, RUSTRIPPER removes rust bloom, paints, shop soils, metal chips, smuts, lubricants . . . leaves tools gleaming clean and naked for visual inspection. Then, a quick dip in Oakite SPECIAL PROTECTIVE OIL keeps rust bloom from forming before reconditioning. Or if they're going into storage, tools and dies get a fast coating of Oakite STEEL PRESERVER for long-term, heavy-duty rust protection.

Ask the Oakite man about a Planned Maintenance Program. He'll gladly give you tips on time-and money-saving materials and methods for plant-wide maintenance cleaning. Meanwhile, send for this PLANT MAINTENANCE CLEANING GUIDE, which gives complete details. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

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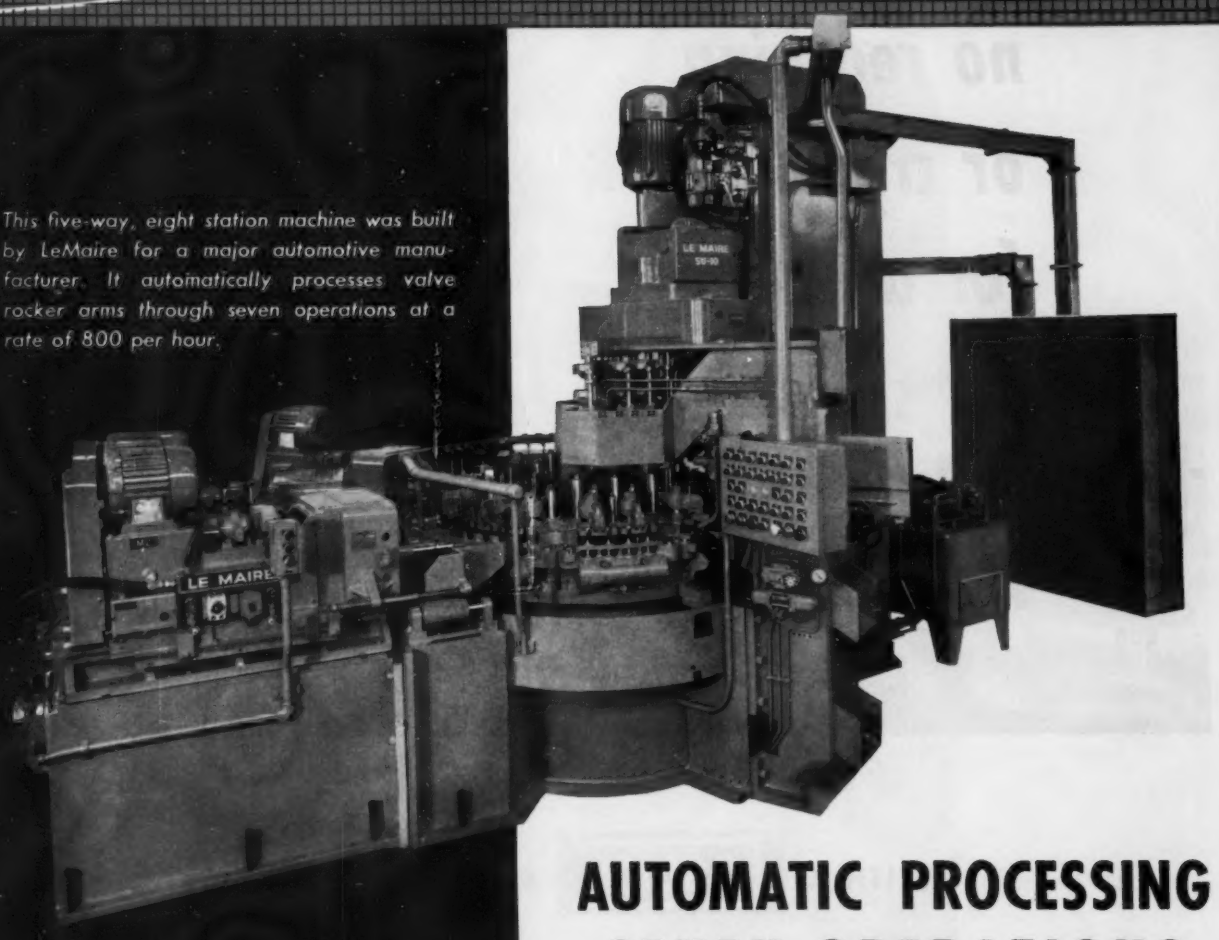
50 *1909-1959 years' leadership in industrial cleaning*

SCIENCE

PRODUCING with LE MAIRE



This five-way, eight station machine was built by LeMaire for a major automotive manufacturer. It automatically processes valve rocker arms through seven operations at a rate of 800 per hour.

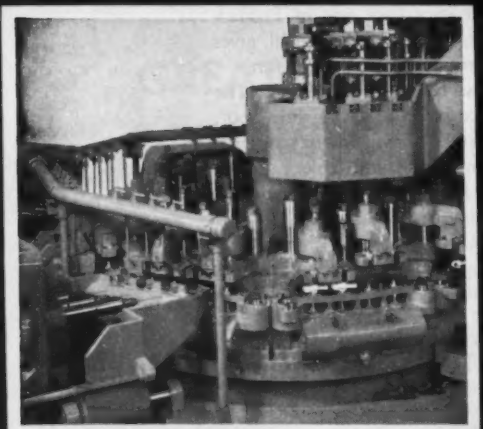
AUTOMATIC PROCESSING

SEVEN OPERATIONS 800 PARTS PER HOUR

The variety of operations and efficiency of this machine clearly demonstrate the versatility of application inherent in LeMaire hydraulic, self-contained way-type power units. They are mounted on this machine in horizontal, vertical and angular positions to perform seven different operations. Here's the eight-station sequence of automatic operations:

(1) Manually load four valve rocker arms
(2) Drill .094" diameter hole at 30° angle
(3) Drill 25/64" diameter hole
(4) Countersink .469" diameter and spot face 7/8" diameter
(5) Tap 7/16"-20 American National Thread
(6) Chamfer .7925" hole
(7) Finish ream .7925"/.7935" hole
(8) Automatically unload and wash fixture

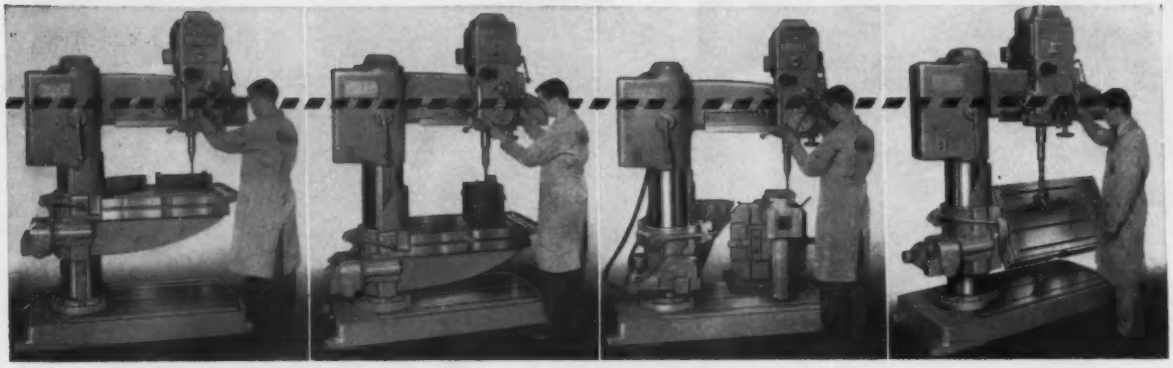
LeMaire engineers specialize in solving production problems—give us a call or write.



Here's a close-up of the automatic hydraulic indexing table. Work-holding fixtures have pilot bushings that register with sliding bushing plate for positive alignment.

LE MAIRE MACHINE TOOL COMPANY
2657 S. TELEGRAPH ROAD
DEARBORN, MICHIGAN
Designers and Builders of Special High-Production Machines

no reaching....
or crouching....
for any job....



WITH A FOSDICK SENSITIVE RADIAL DRILL

You can drill holes up to 1½", in small or large work—*all from the same normal operating position* on this unique machine.

The Fosdick Sensitive Radial Drill is another in a long line of Fosdick "firsts." It fills the gap between the Radial and Sensitive or Upright Drill, gives you exceptional versatility, *plus* operator convenience never possible before.

The arm of this machine—always at the same height—swings 360°. The table, which moves up and down on the one-piece column, also swings 360°. It may be provided with the tilting feature illustrated. A machine base is provided for work too large for the clearance between spindle and table.

Get the whole story on this unique machine. Its moderate price and outstanding features will mean more profitable drilling in your shop. Call your Fosdick Distributor today or write for Bulletin SRM.

THE FOSDICK MACHINE TOOL CO., CINCINNATI 23, OHIO

RADIAL DRILLS
SENSITIVE AND UPRIGHT DRILLS
JIG BORERS & GRINDERS
NUMERICAL CONTROL PRECISION BORING MACHINES
SENSITIVE RADIAL DRILLS

FOSDICK

For more data, circle this page number on inquiry card

INDEX TABLE SPEEDS TO 80 indexes per minute; carries tooling load up to 200 lbs.; 5, 10 and 15 ton models available; tables fit all press sizes.

GREATER PRODUCTIVITY FOR PRESS OPERATIONS

Greater productivity is the happy combination of good machine design and effective tooling. The new HPM C-Press, with index table, provides automatic machine operation with hydraulic power and refinements that aid tool engineers in many different ways. Here are three typical operations and what C-Press offers for each.

SPEED, CAPACITY AND CONTROL FOR AUTOMATIC ASSEMBLY

Completely adjustable for speed, tonnage and stroke; table has hollow spindle through which air, oil or electrical lines may be piped for assembly needs. Full 16" work circle for tooling on dial; high speed with high load carrying capacity; anti-friction bearings throughout. Accurate to .002" with sealed drive unit of barrel-cam design. Complete availability for automatic ejection; large machined mounting pads on sides and throat of press. *More to work with when tooling.*

SEALED DIAL IDEAL FOR BROACHING JOBS

Cutting oil cannot contaminate driving mechanism of the table as the table dial is sealed. Provision beneath the ram station for push-through broaching. Smooth, long, adjustable-speed stroke is ideal for small broaching jobs. Index table broaching increases production by eliminating waiting periods for loading and unloading fixtures. *More advantages for broaching with the C-Press.*

IDEAL CONTROL FOR FORMING AND COMPACTING

The C-Press provides variable speed and pressure adjustments for compacting loose materials. De-airing during compaction is simplified. Better density control with less laminating results. Metal drawing or forming uses same controlled speed and pressure characteristics for better metal flow, less fracture and improved appearance . . . *it's automatic.*

HPM

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Company
Mount Gilead, Ohio, U.S.A.

H 908

For more data, circle this page number on inquiry card

Get new-forging performance at 1/3 the cost from ERIE FOUNDRY REBUILDING SERVICE

Here at the Erie Foundry Rebuilding "Hospital", we disassemble and inspect your forging hammer, remachine worn surfaces, true bearings, replace broken parts, repair cracked parts. Once the hammer is reassembled, tested and put back in operation, it'll be as spry and sound as a new machine—but at one-third the cost!

Stands to reason that the leaders in forge manufacture for over 60 years should be the best source for forge repair.

Regardless of who made it, or how badly it's cracked, broken or worn, your forging hammer will recover most quickly at Erie Foundry's Rebuilding "Hospital". Write for the complete story.

ERIE

THE WORLD'S GREATEST NAME IN FORGING SINCE 1895

ERIE FOUNDRY CO.
ERIE 5, PA.

EF-59-02

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"Our first Natco ran twelve years without an overhaul!"

— says Harry L. Morley, plant manager of Alloy Steel Products Co.

(see other side)

From this job drilling four 1⅛" holes in a stainless steel casting . . .

The operator changes the set-up to eight ⅞" drills in new locations . . .

And starts up again on the new job with only 15 minutes downtime.

"We can change set-ups in 15 minutes or less."

Now, five multiple-spindle Natcos keep production moving at Alloy Steel Products Company, Linden, N. J. Aloyco makes industrial stainless steel valves for the chemical, petrochemical, synthetic fiber, missile and atomic power industries.

Ideal for stainless—Aloyco's materials are hard-to-machine stainless and corrosion-resistant alloys. The steady hydraulic pressure of Natco machines keeps the tools moving into the work and gentles them through the critical break-through point. There's no ease-up to let work hardening start. Drill life stretches out.

Ideal for short runs— Aloyco's production runs aren't long, ranging from 10 to 400 pieces (100 pieces is average). With such short runs, fixtures have to be simple to pay off.

Ideal for cutting costs— An inexpensive guide plate is C-clamped on the face to be drilled and they see no need to fasten the part to the table. Natco C3Bs' accurate alignment, rigidity, lack of vibration and steady feed pressure frequently make permanent fixtures unnecessary.

With a single Natco multiple-spindle machine in your plant you add the productivity of a whole battery of specialized drilling, tapping, and boring machines. Call your Natco representative today.

NATCO

Multiple-spindle drilling, boring, facing and tapping machines.
Special machines for automatic production. Injection molding machines.

NATIONAL AUTOMATIC TOOL COMPANY, INC., RICHMOND, INDIANA

SHORT TOOL LIFE due to chip weld, cratering and burning, in many cases, has been traced directly to lube oil dilution of cutting oil effectiveness. Cleartex can end this problem forever.

Diluted cutting oil shortens tool life drastically

Lubricating oil is probably leaking into the cutting oil sumps of your automatic screw machines as you read this. Current research proves that this is happening in 70% of all the automatics in use today! And where it happens, it shortens tool life by as much as 50%—even 70%. On top of this, the cost of extra regrinds, lost production during tool changes, and excessive scrap production is putting a premium on screw machine operation in too many shops.

Look for these symptoms. One sure sign of dilution is the need for frequent refilling of the lube oil sump. If you are using an ordinary lube oil, this dilution will create two additional—and more costly—symptoms: excessive scrap production and frequent regrinds. Now you can eliminate these forever with the

TEXACO CLEARTEX CURE

The exceptional chemical stability and load-carrying ability of Texaco's Cleartex series make them equally suitable for use as cutting oils, lubricants or hydraulic fluids. All you have to do is use them for both cutting *and* lubrication. With Cleartex in *all* your sumps, you'll find cutting oil dilution will stop and screw machine production cost will drop substantially.

Write today for your copy of Texaco's helpful new booklet "Cleartex in Automatic Screw Machines"...and contact your local Texaco Lubrication Engineer for an authoritative survey of your automatics. Just call the nearest of the more than 2,000 Texaco Distributing Plants, or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y. Dept. MA-23.

Tune In: Texaco Huntley-Brinkley Report, Mon.-Fri.-NBC-TV

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

Big Hit for Decca --DARINA

Decca Records, Pinckneyville, Illinois uses Shell Darina Grease 2 for the entire plant's grease lubrication.

When Decca Records opened its Pinckneyville plant late in 1957, it required a high-temperature grease for the hot plasticizing mills. After testing many greases under actual plant conditions, Shell Darina Grease 2 was selected. In fact, Darina® proved so successful in its original application that Decca now uses it throughout the plant.

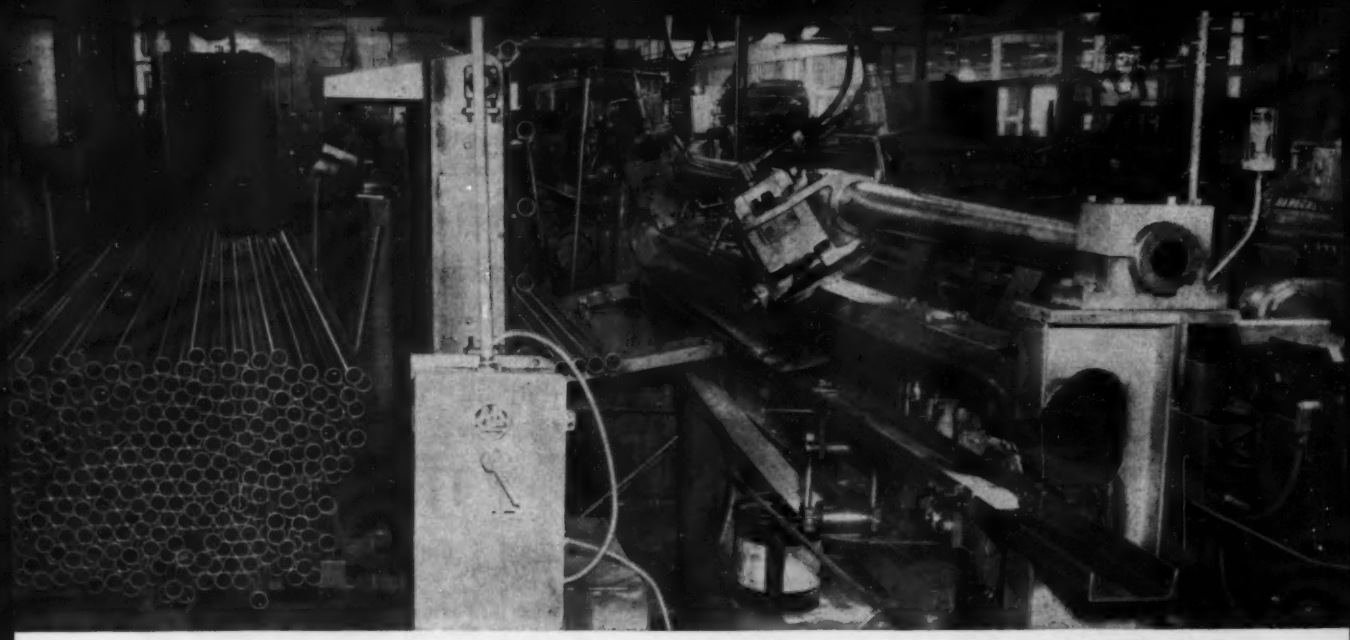
Darina Grease 2 is a premium-quality, multi-purpose grease with exceptional stability in extended high-temperature applications. It offers excellent resistance to corrosion and oxidation. It gives outstanding performance (compared with conventional soap-type greases) for long-time wet or dry applications at temperatures as high as 350° F.

For complete data on Darina Grease, write Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

SHELL DARINA GREASE

the multi-purpose, high-temperature grease

SHELL

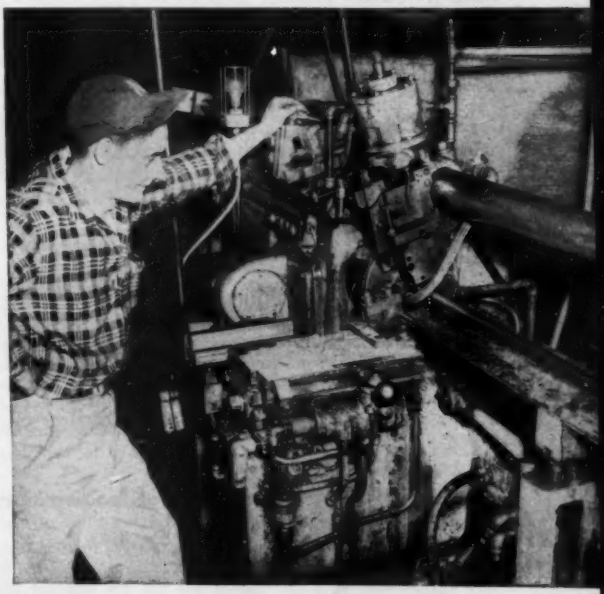


"Flexible Automation"

WITH BARDONS & OLIVER CUTTING-OFF LATHES

at Falls Steel Tube & Manufacturing Co., Newton Falls, Ohio

At Falls Steel Tube & Mfg. Co., manufacturers of exhaust pipes, tail pipes, and similar automotive tubular parts, the output of two electric weld tube mills is automatically transferred to three Bardons & Oliver loading tables. The tubing is then fed into three Bardons & Oliver Cutting-Off Lathes and automatically cut off in any required length from 6 inches to 10 feet. The cutoff lengths are automatically unloaded into tote trucks. Besides wide variance in length, tubing diameters vary from ½ to 3 inches and wall thickness from 14 to 20 gauge.



Victor Beltram, Chief Engineer, reports labor reduced by 75% and cutoff capacity increased by 50% with the Bardons & Oliver installation. Previously, cutoff operations were performed on circular sawing machines. The cutting-off lathes produce square ends and smooth finishes which have greatly facilitated secondary operations. The increased cutoff capacity has allowed greater utilization of all plant facilities. The complete Bardons & Oliver installation has paid for itself in less than three years.

If you cut off spacers, bushings, nipples, couplings, rollers, similar tubular products, or solid bar stock, we suggest you explore the profit possibility offered by these versatile machines. Bardons & Oliver manufactures a complete line of Cutting-Off Lathes ranging in collet capacity from 2 to 16 inches.

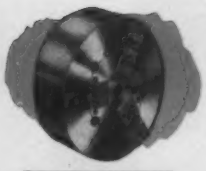
BARDONS & OLIVER

BARDONS & OLIVER, INC., 1135 WEST 9th ST., CLEVELAND 13, OHIO

Manufacturers of Turret Lathes and Cutting-Off Lathes

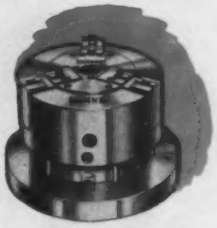
You'll get the job done faster at less cost with Skinner metalworking products

A complete line of hand chucks, power chucks, cylinders, vises



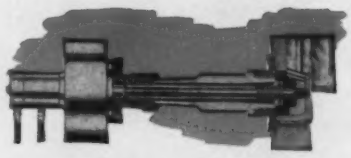
POWER CHUCKS

Provide positive gripping power. Assure accuracy within .001" on diameter on repetitive work. Available in self-centering, combination, serrated jaw, compensating, lightweight self-centering types and in sizes from 6" to 24" diameter. Mount directly on American Standard Type A-1, A-2, B-1 and B-2 flanged spindle noses.



POWER CHUCK FIXTURES

Non-rotating. Hold work for drilling, milling, assembly operations. Air-operated for fast, effortless loading and unloading. In sizes from 5" to 24" with either two or three adjustable or non-adjustable jaws.

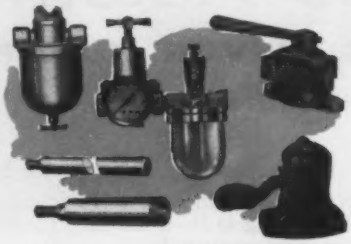


JUNIOR POWER CHUCKING UNIT

Designed to convert small lathes to high production power units. Case histories show users make worthwhile savings. Complete unit includes double-acting air cylinder, adapters, regulator, valve and self-centering chuck with 1/4" to 6" capacity. Components may be purchased separately.

AIR CYLINDERS

Double-acting, rotating operation. Speed production by opening or closing power chuck jaws almost instantly. Large ports assure fast action with minimum air expenditure. Standard sizes range from 4-1/2" to 20". Speeds up to 3500 RPM.

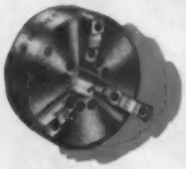


POWER CHUCKING ACCESSORIES

A complete line of power chucking accessories is available: Hand and foot operated valves, draw bars and tubes, air filters, complete air units.

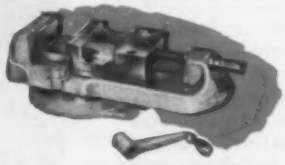
+6F+ WORK DRIVERS

Fastest, surest way to drive 1/4" to 8-1/16" rough or smooth blanks between centers. Used instead of driving dogs. Mount on spindle of any lathe by means of adaptor plate. Engage and disengage workpieces quickly. Positively will not loosen. Have no protruding parts. Hood completely covers jaws. Drivers will work in either direction.



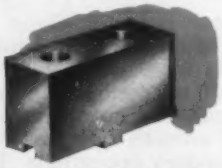
HAND-OPERATED CHUCKS

A large selection of Independent, Self-Centering and Combination chucks. Sizes suited to machines ranging from bench lathes to engine and turret lathes in sizes up to 36". Both direct mounting types and types for use with intermediate adaptor plates.



FULL CAPACITY TROUGH VISES SERIES F AND FS

A complete line of big capacity vises from 4" to 8". Available with or without swivel base. Opening capacity is equal to full width of jaws. Tremendous holding power for rough or finished work. Built-in trough returns coolant to machine table.



SOFT BLANK TOP JAWS

A complete line of medium and heavy duty blank jaws accurately machined to American Standard jaw dimensions. Jaws are low carbon alloy steel which can be carburized and heat-treated to the required hardness—available tongue and groove and serrated jaw types.

Skinner Products are sold through leading Industrial Distributors and Machine Tool Builders and Dealers.

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- Uncle Sam Still "Biggest Customer"
- End of Quantity Aircraft Production Foreseen
- Washington Briefs

Keeping up with Washington

Loring F. Overman

When Congress reconvenes on January 6, 1960, it will be in a good position to evaluate such current events as:

The Eisenhower-Khrushchev exchange of visits—will they ease international tension? Will they merely confirm the vast gulf existing between ideologies?

The steel strike—will its effects require Congressional action to curtail inflation? To relieve distressed areas? To temper the effects of any future work stoppages in major industries?

Will labor-management relations be calmed by newly enacted anti-racketeering legislation, or will members of Congress be pressured to temper labor controls?

What are constituents' viewpoints concerning tax reforms, social security coverage, extension of wage-hour provisions, and increased minimum-wage requirements?

The period between now and January 6 will be a doubly important one for business and industry. It will be a period of legislative respite, a breathing spell before the next round, and an opportunity to make certain that members of Congress know the management viewpoint.

Uncle Sam Still "Biggest Customer"

Uncle Sam continues to be the nation's biggest single customer for goods and services—particularly the kind of goods flowing through products of the machine tool industry. His 1960 fiscal-year pocketbook will total $77,400,000,000 according to Tax Foundation tabulations —$67,200,000,000 in appropriation bills, $8,800,000,000 in permanent authorizations, and $1,400,000,000 in so-called "back-door financing" in the form of contract authority and authority to spend from receipts. Machinery people will be affected by such appropriations as:

Defense Department, $39,228,000,000
Mutual Security, $3,627,000,000
Public Works, $1,182,000,000
Atomic Energy Commission, $2,652,000,000

Excepting for a special mention in the Mutual Security Act of 1959, machine tool manufacturers are beneficiaries of the approved budgets only to the extent that machine tools are needed to produce the "hardware" involved. The Mutual Security Act, on the other hand, sets aside $2,500,000 "from the contingency fund for furnishing United States-owned machine tools and other equipment to small business concerns in undeveloped countries." This latter provision may, among other things, implement buying action by some industrial and commercial missions sent to underdeveloped programs by the Departments of Commerce and State.

End of Quantity Aircraft Production Foreseen

Significant changes in machine tool needs in the field of airborne weapons are forecast by Admiral Robert E. Dixon, who will be the last chief of the Navy's Bureau of Aeronautics. That bureau, together with the Bureau of Ordnance, is being consolidated into a new Bureau of Naval Weapons. Rear Admiral Paul D. Stroop has been designated chief of the new unit.

The new bureau, Admiral Dixon indicated, will comprise one of the largest technological and industrial entities in the country, with a budget of $4,500,000,000 annually. Approximately 40 per cent of all Navy appropriations will funnel through the new bureau, which will also direct 70 per cent of the Navy's research and development funds.

Emphasis on missile production and space conquest will lessen the need for plane production on a quantity basis, Admiral Dixon pointed out. "It seems fairly clear that we will never again need our industry geared to 50,000 planes per year—the peak of World War II. We are doing more and more with less aircraft. I believe that fact is not fully understood."

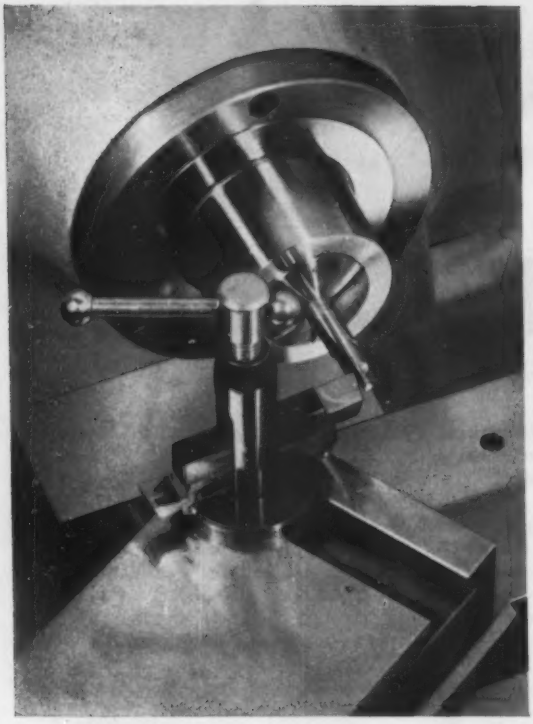
Washington Briefs

Design of airborne weapons may change, as may the machines to produce them, but present producers of military aircraft continue to be regarded by Washington as the approved source of supply. In recent actions by the Office of Civil and Defense Mobilization, seven certificates of necessity for accelerated tax amortization of new defense facilities were issued. Five went to the Martin Co., Baltimore, Md., one to Lockheed Aircraft Corporation, Sunnyvale, Calif., and one to General Chemicals Division, Allied Chemicals Corporation, Metropolis, Ill.

Year-end total outlay for new plant and equipment is expected to reach $33,250,000,000, according to information compiled by the Commerce Department and the Securities and Exchange Commission. This would be 9 per cent above the 1958 allotment, but 10 per cent below that of 1957. Estimates were made without allowances for possible shortages resulting from deferred settlement of the steel strike.

Limiting state taxation of interstate commerce was the purpose of a bill (S 2524) signed into law by the President. The bill prohibits states from taxing the mere solicitation of orders for tangible personal property where the only activity of the seller within the state is the solicitation of such orders and they are sent outside the state for approval or rejection, and, if approved, are filled by shipment or delivery from a point outside the state.

Department of Commerce has announced the printing of new commercial standards for grading abrasive grain of coated abrasive products. Copies of the standard (CS 217-59) are available for fifteen cents from the Government Printing Office, Washington 25, D. C.



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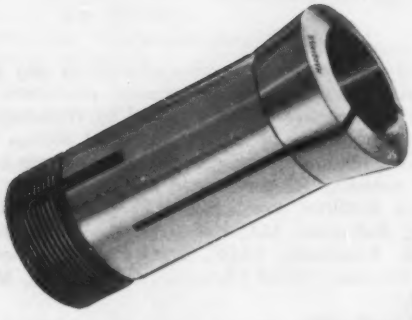

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HARDINGE BROTHERS, INC., ELMIRA, N. Y.

Machinery
NOVEMBER 1959

Robots Are Not Necessarily Scary

HORROR FILMS produced by the motion picture industry occasionally show huge, cumbersome, mechanical-electronic men stalking terrified victims around narrow confines. Fearsome-looking arms try to encircle the victims. Escape from the clutches of the ponderous monsters brings sighs of relief from juvenile viewers of such pictures.

Robots must no longer be considered only in the category of stage or screen props. Machines that incorporate the basic operating principles of the arms and fingers of robots are now being used effectively in industry for an increasing variety of purposes.

July MACHINERY, for example, illustrated the "Handyman" developed by the General Electric Co. for application in radioactive areas of an atomic-aircraft power plant where mortal man could not endure. This device bends its arms and folds and unfolds powerful hands to manipulate objects of almost any shape. The arms have a reach of 9 feet.

More recently, the Hughes Aircraft Co. announced the "Mobot," which is a completely mobile, remote-controlled, mechanical-electronic machine. This equipment has been designed specifically for working in the "hot" areas of Atomic Energy Commission work in testing the effects of radiation upon various materials. It can be actuated by an operator located in another room or building and moved readily in and out of radiation locks and irradiation cells.

Of much wider possible application, and intended especially for use in industrial plants that manufacture products for popular consumption, is a TransfeRobot developed by the Robodyne Division of U. S. Industries, Inc. This machine is a mechanical version of an arm and a many-fingered hand. It is equipped with an electronic equivalent of that small portion of the human brain ordinarily utilized in performing simple, repetitive manual tasks.

This robot will perform many operations in manufacturing and assembling such diverse products as carburetors, toys, electrical components, typewriter parts, fountain pens, computers, and guided-missile units. It will present several parts to a riveting or welding machine, for example, and hold them accurately and securely while the separate pieces are fastened together.

Robots are truly meeting practical needs in the work-a-day world. No longer are their movements confined to the screen and stage.

Charles O. Herb

EDITOR

For this job—or any job of yours—

there's one best material... call RYERSON

When you consult a Ryerson specialist about machining materials, you get *unlimited choice*. With the nation's largest stocks of fast-machining steels, plus abundant quantities of aluminum and industrial plastics, Ryerson can deliver the *one best material* for the job.

Outer races for high-load capacity industrial bearings.

FREE-MACHINING MATERIALS IN STOCK

LEDLOY® STEELS & SCREW STOCK—Ledloy 375: rounds ¼" thru 1¼", hexes ¼" thru ⅞". Ledloy 300: rounds ⅛" thru 3½", hexes ¼" thru 3", squares ¼" thru 2". Also all your requirements for C1213, MX1213, and leaded and non-leaded C1117, C1141.

CARBON STEEL TUBING—All the sizes and wall thicknesses used by automatic screw machine shops are ready for quick shipment, including new Ledloy 170 tubing.

STAINLESS BARS AND TUBING—Here, too, our stocks are the nation's largest, including free-machining Types 303 and 416 in rounds, hexagons and squares.

ALLOY BARS—Complete selection of leaded alloys, including the Rycut® steels—fastest machining in their carbon ranges.

ALUMINUM—Stocks include rounds and hexagons in Types 2011, 2017 and 2024—squares in Type 2024—also tubing at many plants.

POLYVINYL CHLORIDE BARS, PIPE AND TUBING—Bars from ½" to 2½", pipe and tubing from ½" to 14".

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Deep-Drawing High-Strength Cases for Missile Motors

Modern missiles require motor cases made of steels having yield strengths of 180,000 psi and higher. Here's how one company deep-draws high-strength alloy and tool steels to produce these cases

R. S. TOWNEND
Manager—Government Sales
Scaife Co., Oakmont, Pa.

SUPPLYING the Armed Services is for the Scaife Co., Oakmont, Pa., a time-honored experience that started with the making of sponge and tar buckets during the War of 1812. Today, nearly a century and a half later, this company is actively engaged in the development and production of sustainer and booster motor cases for a number of the country's latest missiles.

For a missile to achieve a maximum range, the weight of its parts is necessarily held to a minimum. Thus, unlike commercial pressure vessels, missile motor cases are ideally designed so thin that the steel of which they are made must withstand stresses very nearly equivalent to its yield strength. In short, missile motors require uniform, thin-wall casings satisfactorily heat-treated to high-strength levels (180,000 psi and higher) and containing no disqualifying ma-

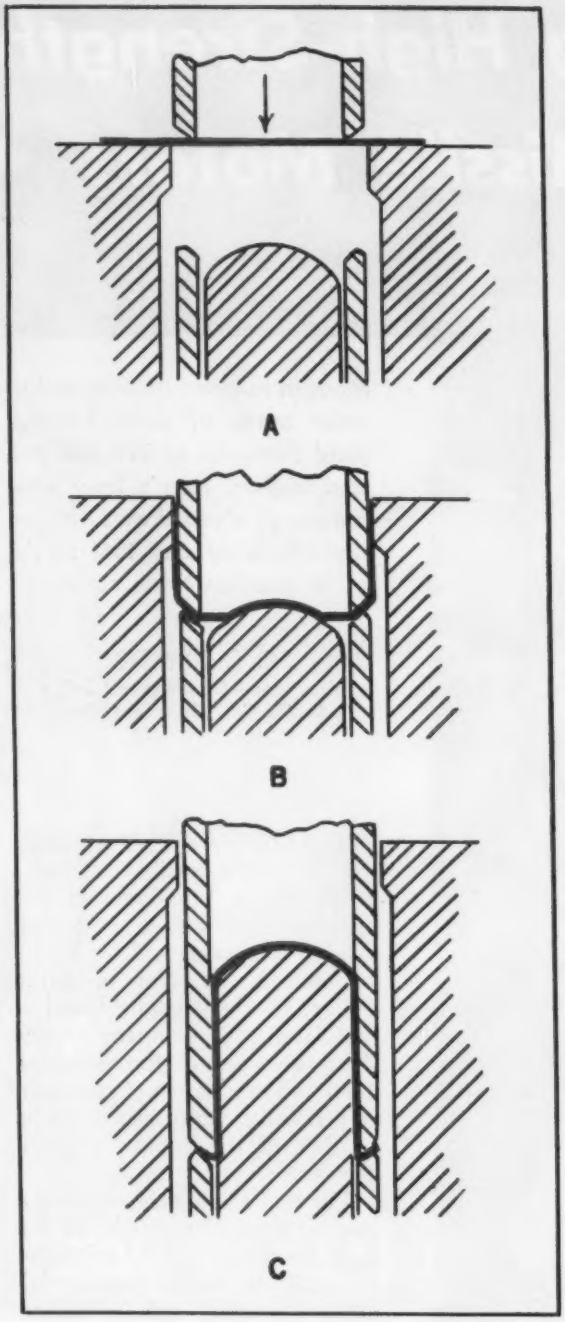

Fig. 1. In the reverse-draw process, a blank is first positioned on the draw-ring, as shown in View A. Then a hollow punch, attached to the ram of the press, descends to draw the blank into a cup, bringing it into contact with a solid lower punch and a spring-loaded backup ring (View B). As the ram continues to descend (View C), the cup is drawn in the reverse direction over the solid punch. Cup is completed at the end of the press stroke.

terial flaws. With the higher pressures developed by the solid propellants, motor cases having yield strengths in excess of 200,000 psi are being sought for some of today's missiles.

Through the use of deep-drawing processes, Scaife has successfully made motor cases from high-strength alloy steels and H-11 tool steel. Long a producer of pressure vessels, the company is equipped to deep-draw cups up to 54 inches in diameter and 50 inches in length. Cases of greater length are obtained by butt-welding drawn sections together. A Nike-Hercules sustainer motor case of two-cup construction and the 1500-ton HPM hydraulic press in which the cups were drawn are shown in the heading illustration. The press is of the triple-action type.

One major problem is obtaining steel with the metallurgical properties that deep-draw satisfactorily, especially since reverse-drawing is frequently employed. Reverse-drawing, which involves both the drawing and then redrawing of a cup in the opposite direction all in a single stroke of a press, is illustrated in Fig. 1. Steel for motor cases must often be specially ordered to the company's own specifications.

Metal that is not going to produce a good motor case will generally fail in drawing. The process, therefore, has an inherent self-inspection feature. Any disqualifying faults that may escape detection during metallurgical inspection are almost sure to be disclosed as the part is deep-drawn.

Motor cases for Falcon air-to-air missiles are made from a single deep-drawn cup. The steel for these cases is produced to company specifications and metallurgically inspected prior to blanking. Spheroidization, cleanliness, hardness, hardenability, ductility, tensile strength, and grain size are among the qualities carefully checked to insure that the material will deep-draw successfully.

Blanks for the cases are discs approximately 23 inches in diameter and 0.085 inch thick. After smoothing of the edges and removal of burrs and slivers, the blanks are given a series of three draws in a triple-action HPM hydraulic press of 150-ton capacity. Two of these operations are reverse draws. A dry-soap lubricant is used.

Between each draw the work-pieces are stress-relieved in an Olson furnace and recoated. The partially drawn cup is then sent to a 750-ton HPM hydraulic press for a final draw and ironing. In each draw, the cases are reduced in both thickness and diameter. Since weight is an important factor, ironing operations are then performed to control the wall thickness to within a few thousandths of an inch. Simultaneously, the length of the ironed portion is controlled to leave a heavier section at the open end for subse-

quent necking and machining of threads. Sonizon ultrasonic equipment is used to check wall thicknesses at pertinent stages of production. Thickness of the ironed portion of the case on completion is 0.050 inch. In Fig. 2, a Falcon motor case is seen about to be removed from the 750-ton press after ironing.

A contoured section is produced at the open end of the case by upsetting the thickened portion of the work-piece inwardly in the necking dies seen in Fig. 3. The press used has a capacity of 150 tons. After the necking operation, all cases are carefully cleaned of the coating material and draw lubricant.

The cases are then heated in an atmosphere of cracked gas to a temperature above the critical temperature for the material. This is done in the Olson austenitizing furnace shown at the rear right in Fig. 4. Test specimens are processed along with the cases and the complete heating cycle is registered on Minneapolis-Honeywell recording instruments.

When properly heated, the work-pieces are individually removed from the furnace and quenched in an oil bath as shown in Fig. 4. Gases are vented from the motor case through the Inconel gooseneck type holder. These can be seen burning as they escape from holes located near the center of the holder. The work-piece is

Fig. 2. One stage in production of deep-drawn motor cases for Falcon air-to-air missiles. The triple-action hydraulic press used has a 750-ton capacity.

Fig. 3. Here, a motor case is being removed from a 150-ton press after necking. This operation forms the thickened portion at the open end of the casing into the necessary contour for subsequent threading.

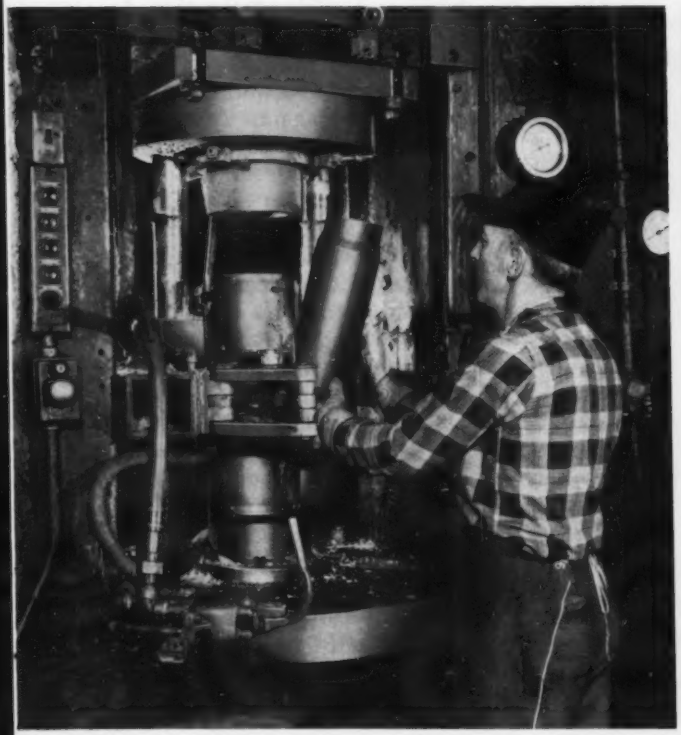

Fig. 4. Falcon motor case being quenched in oil after removal from austenitizing furnace (rear). Burning gases seen escaping from the gooseneck holder are vented from the interior of the case.

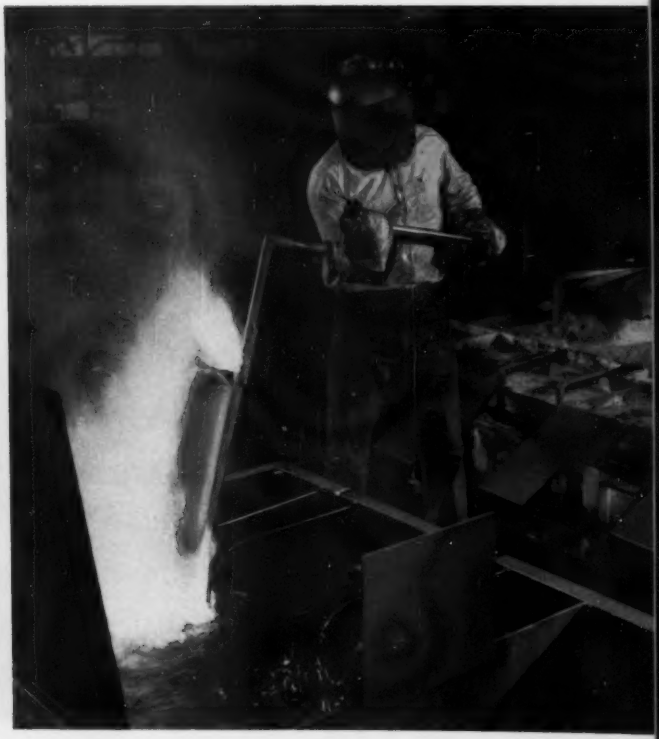

Fig. 5. (Left) Special buttress thread is ground on necked end of motor case. Operator is checking alignment of case prior to thread grinding.

Fig. 6. (Below) Falcon motor cases are twice tested hydrostatically to a pressure of 2750 psi. In addition, a small percentage are tested to destruction, as illustrated.

tempered in a specially built draw furnace to a maximum hardness of 49 Rockwell C and a minimum yield strength of 180,000 psi at 0.2 per cent offset. Each motor case is tested to insure that hardness is held to within a few points on the Rockwell C scale.

Scale, which is present only in minimum quantity, is removed by sand blasting each case in automatic Pangborn equipment. Following sand blasting, the cases are given a thorough, wet magnetic-particle inspection by the Magnaflux method for cracks and other imperfections.

Approximately 2 1/2 inches from the closed end, an area 1/2 inch wide extending around the periphery of the case is built up by metallizing. The resulting special alloy band is then accurately machined to become a locating surface for positioning the motor case inside the missile.

After metallizing, the case is trimmed to length. The necked end is then form-ground to the required contour in an Ex-Cell-O thread-grinding machine equipped with a crush-dressed wheel. In the next operation, an identical machine is used to grind a special buttress thread on the form-ground portion of the case. These threads, which are used for the attachment of adapters and nozzles, are ground to close tolerances, especially on the depth and angle of the thread. A Jones & Lamson comparator is used to inspect the threads on each case.

Because of their relatively thin-wall construction, the cases are supported against the wheel pressure by special mandrels at the open end during both the thread- and form-grinding operations. The closed end of the case is held in a self-centering chucking arrangement. In Fig. 5, an operator is seen checking the alignment of a Falcon motor case prior to thread grinding.

All cases are twice subjected to a hydrostatic pressure test of 2750-psi gage for a short period. In addition, a small percentage of cases, selected at random, are tested to destruction to insure that all requirements have been met. A number of cases that have been checked for bursting pressure are seen in Fig. 6. The lowest bursting pressure of these particular cases was 4060 psi. After a second sand-blasting operation, two coats of special heat-resistant paint are applied, each coat being baked separately. Adapters and nozzles, machined from compatible high-strength steels, are then assembled to the Falcon motor.

Higher Tool Costs Are Often Economical

At what point does an increase in tool life become undesirable in the over-all machining process? Here's what one company discovered after conducting extensive tests

HAROLD W. BREDIN, Associate Editor

BY SACRIFICING TOOL LIFE to the extent that in some cases cutting edges last only a few minutes in actual use, the De Laval Steam Turbine Co., Trenton, N. J., has considerably reduced its over-all machining costs. The greatest savings have occurred since the adoption of carbide throw-away inserts for applications where they are suitable. However, the speeds, feeds, and depths of cut that result in a tool life of thirty minutes were employed as a guide to economic machining at the company a decade ago when only brazed-tip carbide tools were available.

In any manufacturing cost study, it is important, in the final analysis, to evaluate how all of the factors concerned with a process react collectively. Operating conditions that reduce certain costs are often likely to increase others, the most economical procedure being a weighted compromise based on actual dollars and cents values.

A research program at De Laval has shown that the savings achieved, which are primarily the result of greater utilization of machine tool capacity, occur in spite of greatly increased tool costs. This is of particular interest since the company's products include large steam turbines, pumps, and marine propulsion units, involving a substantial amount of short-run machining.

When the production of a machine tool is increased by removing metal at a higher rate, overhead and labor costs per piece decrease while tool and power costs increase. However, since the fixed costs of machining are most often high, the total cost per piece may generally be

reduced simply by increasing production at the expense of tool life.

Tool life for the most economical machining of metals is a function of many variables. Charts developed from extensive tool-destruction tests performed at the company are used to determine the machining rates that result in different tool lives. In these tests, a large number of metal billets were cut with standard type, carbide turning tools, operating under a range of machining conditions. Material hardness, power input to the machine, cubic inches of metal removed, cutting speed, feed, depth of cut, surface finishes, and tool life were all recorded and correlated.

Before the advent of throw-away inserts, the results of these tests were used as a guide in recommending rates for machining steel and cast iron to obtain a thirty-minute tool life. Because they are relatively easy to machine, a thirty-minute tool life for bronze and similar nonferrous metals could not normally be achieved. The ultimate horsepower of each machine was used to determine the best machining rates for these materials.

As a general rule, change-over from brazed-tip cutters to throw-away inserts has allowed the use of carbides one grade harder. Although this would normally effect a 25 to 50 per cent increase in tool life, metal-removal rates were instead increased to maintain the most economic

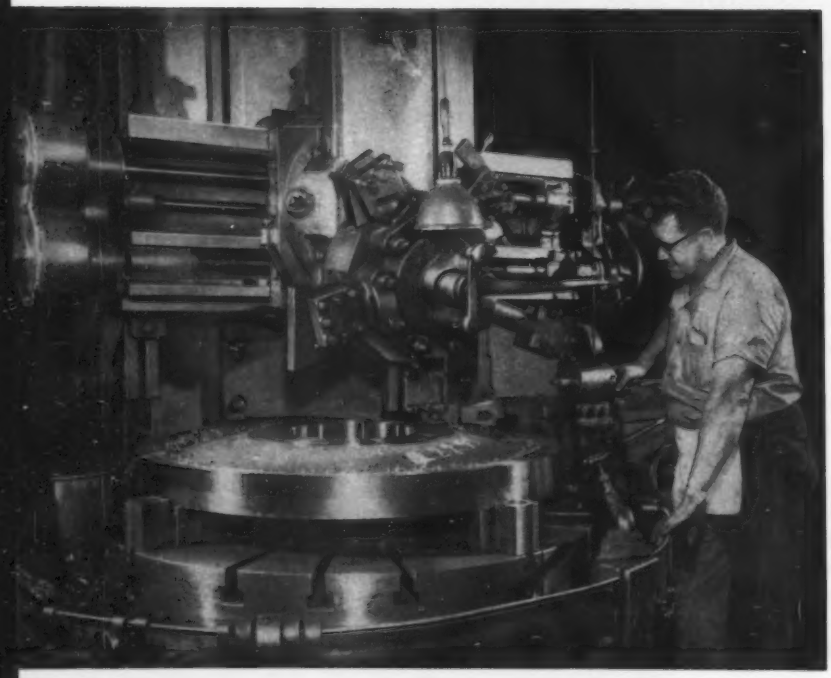

Fig. 1. (Above) Here, metal is being removed at the rate of 14 cubic inches per minute from a pump part made of AISI 416 stainless steel. Tool is a triangular type indexable throw-away insert.

Fig. 2. (Left) Turbine wheel made of AISI 4340 alloy steel having a 240 Brinell hardness is faced using a 1/4-inch depth of cut and a 0.037-ipr feed. Machine speed is 53 rpm and surface speed of work at start of cut is 262 feet per minute.

Table 1. Study of Initial Tool Cost

DEPARTMENT USING SPECIAL TOOLS

Brazed Tools		Throw-Away Tools	
Cost of tip	$ 2.84	Cost of insert	$ 1.80
Cost of Meehanite shank	1.48	Cost of shank	25.00
Milling of shank	1.06	Cost of chip-breaker	1.10
Grinding of tip	0.49		
Brazing of tip	0.21		
Total	$ 6.08	Total	$27.90
Sets of tools required	12	Sets of tools required	7
Total number of tools required (12 × 8 × 3) =	288	Total number of tools required (7 × 8) =	56
Total cost of tools (288 × $6.08) =	$1751	Total cost of tools (56 × $27.90) =	$1562

Savings on first set of tools = $1751 − $1562 = $189

DEPARTMENT USING STANDARD TOOLS

Brazed Tools		Throw-Away Tools	
Cost of tip	$ 1.25	Cost of insert	$ 1.80
Cost of Meehanite shank	0.48	Cost of shank	12.00
Milling of shank	0.97	Cost of chip-breaker	1.10
Grinding of tip	0.49		
Brazing of tip	0.21		
Total	$ 3.40	Total	$14.90
Sets of tools required	24	Sets of tools required	10
Total number of tools required (24 × 8 × 3) =	576	Total number of tools required (10 × 8) =	80
Total cost of tools (576 × $3.40) =	$1958	Total cost of tools (80 × $14.90) =	$1192

Savings on first set of tools = $1958 − $1192 = $766

machining conditions. In addition, reduced cutter costs made possible by the adoption of throw-away type tooling have led to a shorter economic tool life in many cases. As a result, recommended machining rates have been increased further.

Today, at De Laval, feeds, speeds, and depths of cut for certain jobs are chosen to limit tool life to as low as five minutes. On the other hand, special tooling situations sometimes require a tool to last as long as two hours. Insufficient rigidity of the tool, the work-piece, or the machine may dictate the choice of operating conditions that result in an increased tool life. An underpowered machine can do the same. For this reason, the motors on some machines at the company have been replaced with those of greater horsepower. Machine construction, however, has prevented motor replacement in many instances.

Occasionally, the time required for a long cut is found to exceed the recommended economic life of the cutter to be used. In such cases, especially when finishing cuts are taken, machine feeds and speeds are reduced, increasing tool life to permit completion of the cut with a single edge.

The heading illustration shows an 80-inch diameter gear wheel for a large marine propulsion unit being turned on a Betts vertical boring mill equipped with a 96-inch table. The material of this gear is made to ASTM A290 Class B specifications for carbon-steel forgings for reduction gears, and has a hardness of 185 Brinell. In roughing, a 1/4-inch deep cut is taken at a

Table 2. Regrinding of Brazed Tools versus Use of Throw-Away Inserts

Average grinding time per tool = 7 min.
Labor and overhead cost per minute = $0.07
Cost to grind one tool = 7 × $0.07 = $0.49
Number of grinds per tool life = 12
Total grinding cost per tool = 12 × $0.49 = $5.88

Cost of throw-away insert = $1.50
Brazed tools provide twelve cutting edges during the life of the tip against six cutting edges for the throw-away insert. Therefore, two throw-away inserts are equivalent to each brazed tip.

Grinding cost of brazed-tip tool = $5.88
Cost of throw-away inserts (2 × $1.50) = 3.00
Saving $2.88
or $0.24 per edge

Table 3. Resumes of Three Tool-Life Investigations

Part	Bearing bushing	Scraping bar	8-inch diameter boring-bar, 12 feet long, having tool-holder holes and four keyways
Machine	Turret lathe	Large lathe	Large lathe
Grade of carbide	K2S	K21	
Material	1020 Steel	Cast iron	4140 Steel
Feed, inch per revolution	0.023	0.030	0.023
Length of cut	3 1/2 inches	16 feet	1 inch of material removed from diameter
Depth of cut, inch	3/16	1/8	1/8
Surface speed, feet per minute	290	150	150
Throw-away insert tool life	60 minutes	Duration of cut	Duration of job
Brazed-tip tool life	46 minutes	Failed	Two tools broke after 6 inches of cut

speed of 7.8 rpm (163 surface feet per minute) and a feed of 0.093 ipr (inch per revolution). These machining conditions result in a thirty-minute tool life for the Kennametal grade K2S indexable throw-away insert used. Since the face of the gear wheel is 22 inches wide, approximately thirty minutes are required to complete the cut. The tool must, therefore, be indexed to a new edge after each roughing pass.

In Fig. 1, a sleeve made of AISI 416 stainless steel for a shaft of a centrifugal pump is seen being turned in a Warner and Swasey turret lathe. The operator is using a Kennametal K6 grade triangular indexable insert to remove approximately 14 cubic inches of metal a minute with a 1/4-inch depth of cut, a 0.020-inch feed, and a speed of 249 rpm. The part is 3 1/2 inches in diameter and has a hardness of 210 Brinell.

Another typical machining operation at the plant is the facing of the turbine wheel illustrated in Fig. 2. The part is produced from AISI 4340 alloy steel and has a 240 Brinell hardness. In this case, a 1/4-inch facing cut, started on a 19-inch diameter, is seen being taken at a feed of 0.037 ipr and a table speed of 53 rpm. The machine is a Bullard vertical turret lathe and the tool, a mechanically held triangular insert of Kennametal K2S grade.

An incentive program has not only been instrumental in the success of the company's efforts in reducing tool life to obtain the most economic machining rates, but also in speeding the adoption of throw-away carbide inserts and their holders wherever possible. In addition to permitting higher metal-removal rates, initial costs of throw-away insert tooling have proved to be less, the average time required for changing cutting edges has been reduced from four minutes to one minute, and the per-edge cost of brazed tools (considering regrinding) was found to be substantially higher than that of throw-away inserts. Chip control was also found to be better with throw-away type tooling.

In making a study of the initial costs of both types of tooling at the plant, it was found necessary to investigate two departments—one where standard catalogue tools are used, and one where special tools are purchased. In these departments eight styles of tools and three grades of carbide for each style were required for every set of brazed tools. Since one tool shank can accommodate all grades of carbide and since spare sets are not a necessity because of the relative ease in changing inserts, the number of tools required in each department was substantially lower for the throw-away type. The results of this cost study made several years ago for the two departments are shown in Table 1. A comparison of brazed-tool regrinding cost against that of throw-away inserts (for the same study) is given in Table 2.

Numerous tool-life comparisons were made at the company and it was found in all instances that the life of the throw-away type tools at least equaled that of the brazed type and in a number of cases was approximately double. A resume of several of these tests is given in Table 3.

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Government Patents Available for License

The Office of Technical Services, U. S. Department of Commerce, has announced the publication of a new series of abstracts of patents owned by the Government which can be licensed at no charge by private firms and individuals for non-exclusive use. Published in seven booklets called "Supplement No. 2, Patent Abstract Series," the abstracts describe patents released for licensing between July, 1955, and June, 1958. The booklets range in price from 50 cents to $1.75, with the one entitled "Metal Processes and Apparatus, Machinery, and Transportation Equipment" (PB 151509) selling for $1.25 per copy.

Production Metallizing Improves Rotor Blades, Cuts Costs

ALMOST EVERY PRODUCT on the market today has been, or is being, subjected to an evolutionary process of improvement. No exceptions are the Flexidyne industrial drives and couplings produced by the Dodge Mfg. Corporation of Mishawaka, Ind.

Flexidyne is a transmission marketed for use on industrial machinery operated either by electric motors or internal combustion engines. Although the transmission is similar to the hydraulic fluid drive, it uses a "dry fluid" consisting of heat-treated steel shot.

A measured amount of the shot, called the flow charge, is contained in an aluminum housing keyed to the motor shaft. When the motor is started, centrifugal force throws the flow charge outward and packs it between the housing and a rotor. The rotor transmits power to the load. After a brief starting period the rotor and housing become locked together and achieve full-load speed, operating without slippage.

From this brief description of the unit's operating principle it can be realized that the rotor blade must function under the severest of conditions. One of the earliest problems was the abrasive effect on the blade from the shot tumbling around it. (The shot does not slip against the aluminum housing.) For several years experiments were made with various grades of steel, each time using a harder one. When a steel of sufficient hardness to withstand the wearing of the "fluid" was used, it was found to be too brittle to stand the thermal and mechanical stresses. Actually, the solving of one problem created another equally as serious.

A satisfactory answer did not lie in the selection of any one metal, but rather in a combination of metals. This type of rotor construction was arrived at by metallizing. The parts, ranging in diameter from 7 to 25 inches, are first stamped to the required shape from 1/8- to 1/4-inch-thick SAE 1020 steel. Surfaces to receive the sprayed coating are prepared by blasting with steel shot, Fig. 1.

Two Type P Metco spray guns are used for the metallizing operation. As shown in the heading illustration, they are mounted on a fixture that directs the sprays against both sides of the rotor blade. The work is held in a rotating fixture so that the hard facing is applied equally around its periphery to a thickness of approximately 0.045 inch.

An oxy-acetylene gas is used to fire the guns. Metal powder is gravity-fed to them from metal canisters suspended overhead (heading illustration). The alloy is a self-fluxing type compounded from nickel, chromium, and boron, and containing a high percentage of tungsten carbide.

Once the hard facing has been built up to the proper thickness the rotor blades are transferred

Fig. 1. Rotor blades range from 7 to 25 inches in diameter. Here, peripheral surface of one blade is blasted with steel shot to prepare it for metallizing.

to the setup shown in Fig. 2. Here, as the operator rotates the large handwheel, the outer edge of the work-piece travels between two oxy-acetylene heads that bring the sprayed coating to a temperature of 1900 degrees F. and fuse it to the base metal. This process has yielded a highly ductile steel rotor blade with a facing so hard that it has shown virtually no signs of wear after months of continued laboratory testing.

Before adapting metallizing to its Flexidyne production, Dodge was paying up to $1.30 per pound for steel of sufficient hardness to resist the shot abrasion. Furthermore, annealing was required after forming and drilling. Now that a sprayed coating provides the necessary wear resistance around the edges, steel at $0.07 per pound is being used. Another advantage is that the less-expensive steel is softer and more shock resistant.

This is not all monetary gain—the initial cost of installing the metallizing equipment and the continuing cost of spraying each part must be considered. However, the over-all saving has been approximately 30 per cent.

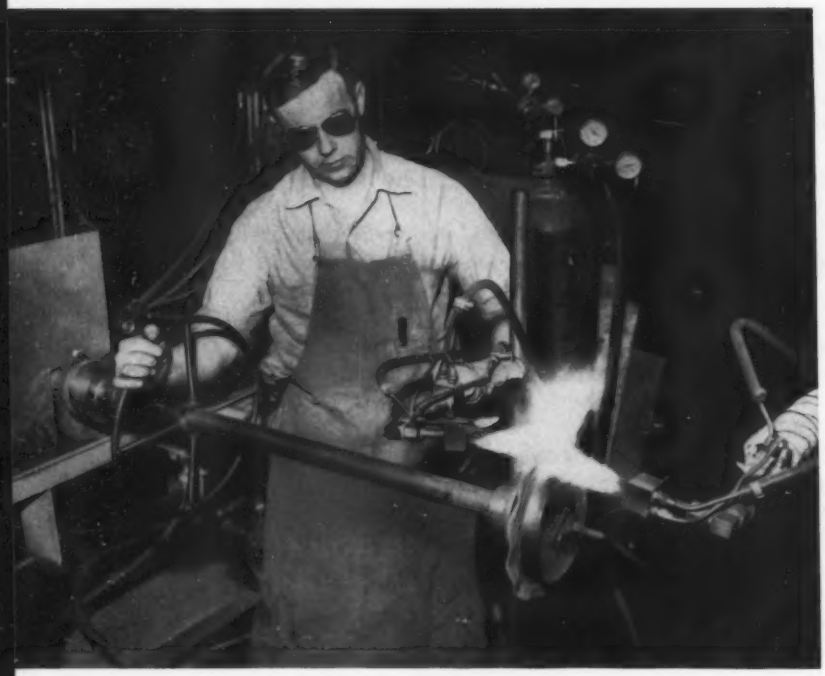

Fig. 2. After an approximately 0.045-inch-thick layer of sprayed metal has been applied (heading illustration), the rotor blades are rotated between these two oxy-acetylene heads. The coating is heated to 1900 degrees F. and fused to the base metal.

CONVAIR'S EXPERIENCE WITH CERAMIC MILLING CUTTERS

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WHAT will tomorrow's cutting tools be like? This is a question frequently in the minds of production men and engineers responsible for developing means of machining the new metals that come out from time to time to meet the demands of aircraft and missile designers. Alloys that are of higher tensile strength and capable of withstanding the temperatures developed in the flight of planes and missiles are constantly being sought. The machining of such alloys presents problems.

In the search for new cutting-tool materials, Convair engineers decided to investigate the possibilities of milling cutters made from aluminum oxide. A program directed toward that end was set up in cooperation with ceramic and cutter manufacturing companies. Results of research conducted under that program will be described.

An important objective was to try and produce expendable cutters—that is, cutters sufficiently low in cost that it would be economically feasible to throw them away when they became dull, rather than to resharpen them. Obviously, to achieve this aim it would be necessary to develop cutters that could be purchased at approximately resharpening costs, although consideration should be given to the economies effected through reduced floor space and other factors.

Extensive tests have been made on a number of ceramic shell end mills of different configurations. All of them were 2 inches in diameter. They were made with either four or six teeth. Various tooth-angle combinations were experimented with, ranging from 15 degrees negative axial rake and 10 degrees negative radial rake to 15 degrees positive axial rake and 10 degrees negative radial rake. In all cases, the radial rake was negative. The illustrations show side (Fig. 1), front (Fig. 2), and rear (Fig. 3) views, respectively, of a typical cutter. There is a chamfer of 45 degrees on the front end of the teeth and 100 degrees at the corner.

Materials machined with these cutters included 7075-T6 aluminum alloys, SAE 4130 steel, 6AL-4V titanium, cast iron, and stainless steels. In these operations the cutter was mounted on a No. 50 taper arbor and driven by a steel key in the arbor which engaged the slot that runs across the back of each cutter.

Motion pictures taken of the tests at speeds up to 7000 frames per second enabled observers to determine exactly what was happening. For example, in cutting 2024 aluminum at 900 fpm (feet per minute) with a cutting depth of 0.250 inch and a table feed of 35 ipm (inches per minute), the cutter did a fine job at the beginning. Later, however, scenes showed that chips welded to the cutter teeth. This resulted in considerable heat and a poor work finish.

The same billet was then machined at a depth of 0.350 inch, the feed and speed being kept the same. The increased depth of cut resulted in better chips. When the billet was machined at a speed of 900 fpm and a cutting depth of 1/8 inch, the chip formation was good at the beginning of the cut, but as the heat generated into the curled chips they tended to weld to the teeth and were carried to the next point of contact with the work. Here they were knocked off.

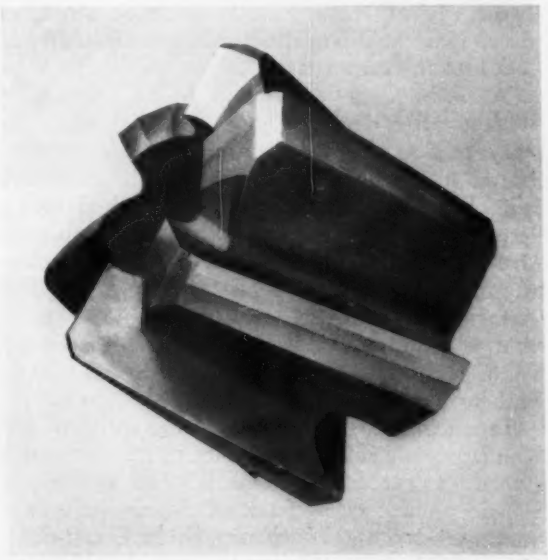

Fig. 1. Side view of ceramic milling cutter 2 inches in diameter which has successfully machined various metals.

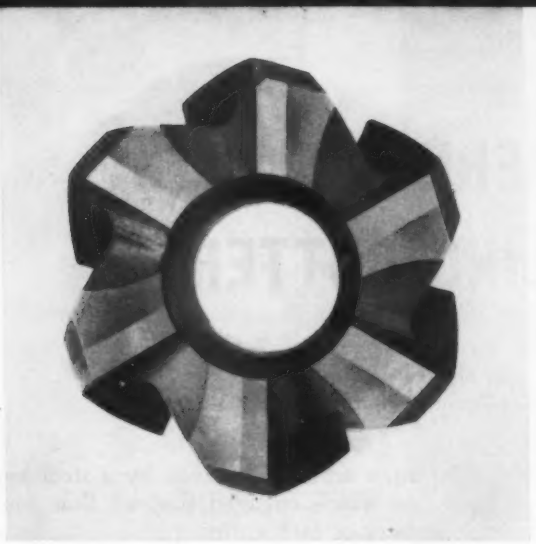

Fig. 2. Front view of the ceramic milling cutter seen in Fig. 1, showing tooth chamfers.

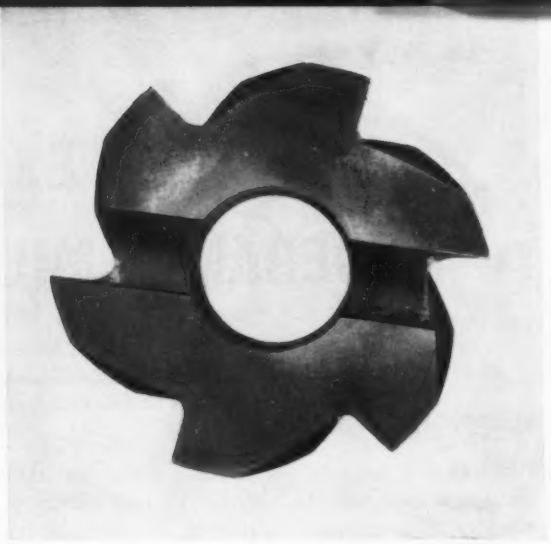

Fig. 3. A driving slot extends across the back of the ceramic cutter.

When the cutting speed was changed to 800 fpm and the depth of cut, to 0.200 inch, a considerable amount of welding was again encountered. The chips were very straight and did not form into a tight curl as before. The increase in the depth of cut was considered responsible for the change which resulted in an increase in the heat generated. The chips were recut as each cutter tooth re-entered the work. This condition causes the cutting teeth to chip and as a result tool life was very short.

When the depth of cut was increased to 0.300 inch, the surface speed to 900 fpm and the feed to 45 ipm, a much cleaner chip was obtained and there was very little welding of the chips to the cutter teeth. A ragged edge was produced at the bottom of each chip by the small chamfer on the corners of all teeth. Less welding occurred because more heat was dissipated into the chip and less into the cutter itself.

A slotting cut was found to be impractical with a cutter having a negative radial rake. The chips tended to push ahead of the teeth and were boxed in instead of traveling up the flute and out of the slot. The chips were pushed into a letter "S" shape. For a cut of this type, high positive-rake angles are required in order to clear the chips. The fact that aluminum-oxide cutters did not disintegrate under these conditions shows that there are possibilities of manufacturing ceramic cutters that will give good chip control and longer tool life.

In machining cast iron, a cutting speed of 500 fpm was used with a feed rate of 22 ipm and a depth of cut of 0.100 inch. The customary powdery chips were obtained. Since cast iron is very abrasive and aluminum oxide is quite resistant to abrasion, this combination should prove very beneficial.

In milling a titanium-alloy billet containing 4 per cent aluminum and 4 per cent magnesium, a considerable amount of heat was generated at the cutting tip due to the toughness of the material. Again the chips welded to the cutter teeth. A cutter with a neutral radial axial rake used with a proper feed and speed combination will reduce this tendency and help produce the desired chip formation. The aluminum-oxide cutter was able to withstand the impact of the cut without shattering.

In a test on a billet of SAE 4130 steel having a Rockwell hardness of 33 C, a cutter speed of 450 fpm was used, with a table feed of 15 ipm. The cutter had a positive axial rake. Although chips welded to the teeth, there was the indication of a potential use of aluminum-oxide cutting tools on such material. After the cut was completed, it was observed that there had been a slight chipping of the teeth on the sharp corners.

When the same billet of steel was machined with a negative radial and negative axial rake cutter, at the same speed and feed, but with a greater depth of cut, there was no welding of the chips to the cutter. All chips were thrown clear of the work-piece. The work surface was very smooth and no chipping of the teeth had been encountered.

In the opinion of Convair engineers these tests have indicated that, with the cooperation of manufacturers, ceramic tools can be produced which will help the aircraft and missile builders to machine the high-tensile alloys necessary to reach the future speeds and altitudes that will be demanded of their products. One important point must be borne in mind, and that is that a ceramic milling cutter must be inherently strong enough to withstand the cutting stresses imposed on it. The working conditions are vastly different than when a ceramic turning bit is reinforced by a steel holder.

DIE-CAVITY DESIGN... Should a Land Be Included?

FEDERICO STRASSER, Santiago, Chile

SHOULD THE CAVITY of a blanking or piercing die be fully tapered, or should it include a straight land for a short distance from the surface of the die? There has long been disagreement over which design is better, since each has certain advantages and disadvantages.

The fully tapered and straight-land-and-tapered styles appear in Figs. 1 and 2, respectively. To show the draft, or clearance (angle *a*), it has been exaggerated in each instance. In the fully tapered design, it varies from 15 minutes to 1 degree 30 minutes per side. The exact value of the angle depends on such considerations as production quantities (the greater the quantity, the smaller the angle); stock strength (the harder the material, the smaller the angle); blank size (the larger the blank, the smaller the angle); and stock thickness (the lighter the gage, the smaller the angle).

Where a land is incorporated in the wall, its height is proportional to the stock thickness. Lands are approximately 1/8 inch high for stock up to 0.040 inch thick, and 3/16 to 5/16 inch high for thicker stock. For hard metals which must meet high-precision requirements, a design (Fig. 3) which is a cross between the two thus far considered is sometimes used. Here, the land is not straight, but itself has a small clearance angle *b* of 10 to 20 minutes. Angle *a* in the design in both Figs. 2 and 3 is relatively large—usually more than 1 degree.

It is evident that the straight land produces a 90-degree cutting angle, and the cutting pressure required is somewhat greater than in the case of a smaller cutting angle. Also, if thick or hard material produces a bellmouth on the die cavity, the punchings, after being severed from the stock ribbon, must be pushed through an opening that is smaller in cross-section than their own—creating a burnishing action and a need for greater pressure.

Again, if the land height is considerable, a bellmouth condition can cause the punchings to be pinched so that they jump up onto the surface of the die and create trouble, instead of dropping through the bottom of the cavity. Another disadvantage is that the straight land is apt to become clogged with punchings, since a greater number of them are held simultaneously in the cavity.

On the other hand, dies having fully tapered cavities experience a useful life 20 to 40 per cent greater. They retain the sharpness of the cutting edge longer, since there is less friction; and there is less tendency to become bellmouthed, therefore

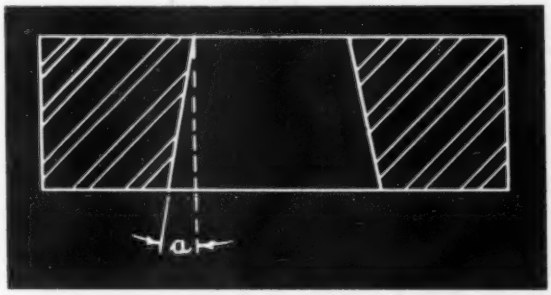

Fig. 1. In fully tapered die cavity, the draft angle (a) is usually 15 minutes to 1 degree 30 minutes.

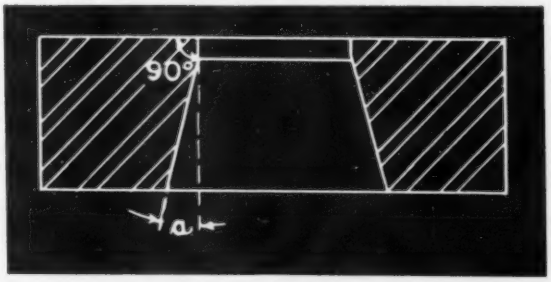

Fig. 2. Straight land at top of cavity preserves original die dimensions after regrinding, but shortens die life.

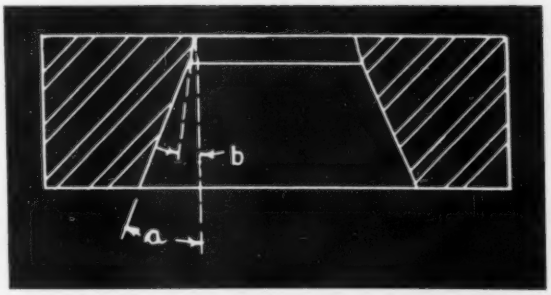

Fig. 3. With the land itself having a slight taper (b), some of the objections to a straight land are overcome.

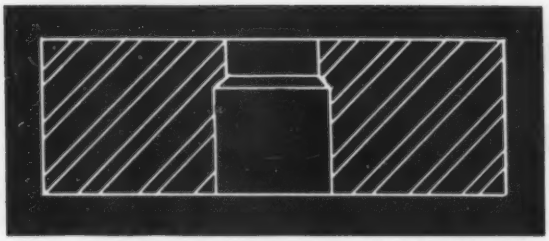

Fig. 4. Instead of a clearance angle, the die cavity beneath the land can consist of an oversized hole.

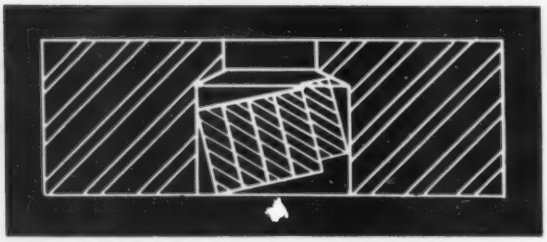

Fig. 5. The punchings will accumulate and jam die if too big a hole is drilled beneath die cavity.

less chance of producing burrs on the edges of the stamped parts.

Does the style of the cavity affect the die-making cost? Where the die room is mechanized and the filing and grinding are done by machine, the fully tapered cavity is quicker to produce and therefore cheaper. But if finishing of the cavity has to be done on the bench, the straight land is easier to file and hand-stone.

The chief advantage of the straight land is that the original dimensions of the die are retained after repeated regrinding. This claim is largely discounted, however, by the insignificance of the change in size after regrinding of many dies with fully tapered cavities. For example, there is a maximum increase of only 0.0027 inch per side over a distance of 5/16 inch where the clearance angle is 30 minutes. (A distance of 5/16 inch is used to correspond to typical land height.) Thus, after any one regrinding, the increase in the dimensions of the die is infinitesimal. In any case, the enlargement caused by regrinding does not alter the precision of the work; an increase in the size of the burr formed seems to be more of a shortcoming. It is the punch size, not the die size, which controls the precision of the stamped hole.

In one instance, in particular, a straight land is mandatory. That is where the material is ejected from the surface of the die, rather than through it, such as with a compound die. Here, a fully tapered cavity would increase die wear unnecessarily.

If a tapered reamer of the required size is not available to produce the angular clearance for a small, round piercing hole, the cavity can be drilled out from the bottom, as in Fig. 4. The drill used for this clearance hole should be only slightly larger than the cavity diameter. It should not be so large that the punchings drop into a vertical, or near vertical, position, as in Fig. 5, and jam the die.

Chemically Etched Honeycomb

Honeycomb core is being contoured by chemical etching at the Chemical Milling International Corporation, El Segundo, Calif. This process is of great interest to the aircraft and missiles industry because it eliminates the barrier encountered in close-tolerance matching of contoured core to specific skin design. Its particular advantage to aircraft design stems from the use of an integrally stiffened skin produced by chemical milling, which is subsequently matched to the honeycomb core for each individual part.

Recent changes in tolerance specifications have tested the ingenuity of the industry, since usual cutting and grinding techniques tend to crimp and otherwise impair the expensive honeycomb raw material. One approach has been to freeze the honeycomb in a block of ice, then machine ice and metal together. Another attempt at a solution is the use of a spark-gap wheel, which uses a high electrical charge to vaporize the edge of foil being worked. While both approaches have had limited success, the cost of clean, finished honeycomb core ready for sandwich fabrication has remained excessively high.

Etching, which does not involve pressure, vibration, or excessive heat, is considered by experts in the field to be the most logical solution to the problem of close-tolerance cutting of a large area of foil edge, which now constitutes the principal bottleneck in the use of honeycomb. Moreover, controlled masking and etching is now believed to be the only practical way of contouring honeycomb core so that fabricators can make wider use of this strong, light material.

By employing a patented masking technique and the etching know-how gained in chemical milling, CMI aims to provide a dependable, low-cost means of preparing the raw honeycomb core.

DRILLING THE HOLES THAT PROVIDE FUEL FOR OUTER-SPACE PROPULSION

How the Rocketdyne Division of North American Aviation, Inc., solved a formerly pestiferous problem—the drilling of hundreds and thousands of minute holes in injector heads

CHARLES O. HERB, Editor

LIQUID-PROPELLANT ENGINES and advanced forms of propulsion for use in outer space are fascinating products of the Rocketdyne Division of North American Aviation, Inc. This division was a pioneer in the development of engines ranging in capacity from a few pounds of thrust to engines powerful enough to lift a hundred tons of ballistic missile into the air and thrust it through space at speeds up to 15,000 miles an hour. Engines have been built for such noted missiles as the Army Redstone and Jupiter, and the Air Force Thor and Atlas.

The Rocketdyne plant at Canoga Park, Calif., is devoted to the design and fabrication of prototype rocket-engine models and the manufacture of engines that have reached the production stage. One of the most important engine components is the injector, which is required in a variety of designs, some of them classified. Hundreds and thousands of minute holes, depending upon the type, must be drilled in the injector heads. Accuracy of location and the small hole sizes originally presented problems that were difficult of solution. This article will describe four different machines that brought injector drilling down to a practical basis. The general policy at Rocketdyne is to use standard machine tools wherever possible. This is an instance, however, where special equipment was necessary because of the type of work involved. In designing the equipment it was desirable to make each machine as flexible as possible to provide for engineering design changes in the work-pieces.

Holes as small as 0.030 inch in diameter are

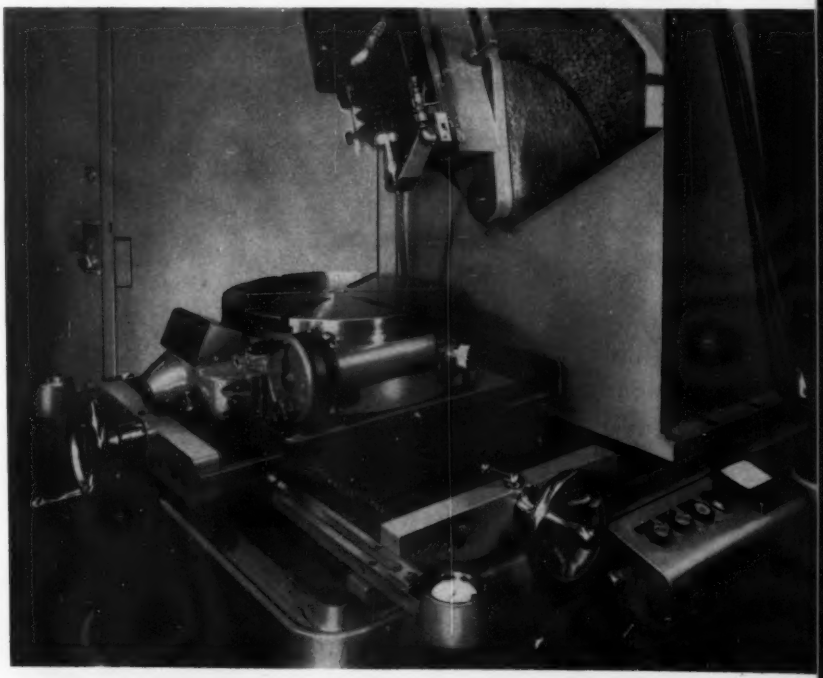

Fig. 1. Injector-hole drilling machine equipped with optical indexing arrangement and torque-reading instrument that indicates dulling of drills.

customarily drilled in injector parts but smaller holes are being specified for the future. The average maximum depth of injector holes is 3/8 inch. Drills last for between forty and fifty holes between resharpenings. A standard drill point is provided, but it is precision-sharpened. Guide bushings are used, close to the work. Injector parts in which the holes are drilled are made from such varied materials as SAE 4130 chromium-molybdenum steel, stainless steels, copper, and aluminum alloys.

Hundreds of holes, and sometimes thousands, are often required in individual parts. The common pattern consists of a "family" of three holes, one of which is vertical. The other two holes are on opposite sides of the vertical hole and are disposed at angles to intercept the vertical hole at a specified point. The tolerance on the interception of the holes is 0.001 inch. Holes less than 0.080 inch diameter must be to size within plus or minus 0.0005 inch and free of burrs, while holes of that size and larger must be to the specified diameter within plus or minus 0.001 inch. The center-to-center distances between respective families of holes is generally held to plus or minus 0.003 inch. The most critical portion of the minute holes is the exit section or the last portion drilled.

Inspection of injector holes is a formidable task. Every hole must be checked for diameter by using a minute plug gage. The intersecting point of the three center lines of each family of holes is inspected with pins.

The simplest of the special machines is used in drilling holes in gas-generator injectors. The individual motor-driven heads are arranged for producing a family of three holes. These heads are mounted in fixed vertical and angular positions. Each spindle is fed individually by the operator pulling down on a corresponding lever. Speeds can be quickly changed to suit hole diameters and different materials from which the injector parts are made. The 1/4-hp, variable-speed motors have a maximum speed of 5000 rpm at full load.

The work-fixture is provided with five index-plates having holes around their peripheries in each of which a locating pin can be inserted to obtain accurate radial settings of the work. The height of the pin can be changed so that it may be used in conjunction with the five plates. More than one hundred different settings can be obtained with this fixture. The fixture is mounted on a dovetailed slide so that the work may be moved transversely in relation to the spindles.

Optical means are provided on the machine illustrated in Fig. 1 for making table settings to extreme accuracy at desired radial angles on injector parts. This machine is of a universal type applied for drilling gas-generator and vernier-engine injectors. It is intended for drilling holes in different family combinations and for this reason the drill head is angularly adjustable on the column. In addition, the rotary indexing table is mounted on a combination of two carriages that provide for transverse and longitudinal adjustment with respect to the drill spindle. Length measuring bars are used in combination with Starrett dial gages to obtain accurate settings in these two directions.

Operation of the drill head is completely automatic for producing each hole. The operator depresses a button to actuate the downward movement and at the end of this movement, the drill head retracts to its starting position. The variable-speed motor on this machine has a maximum

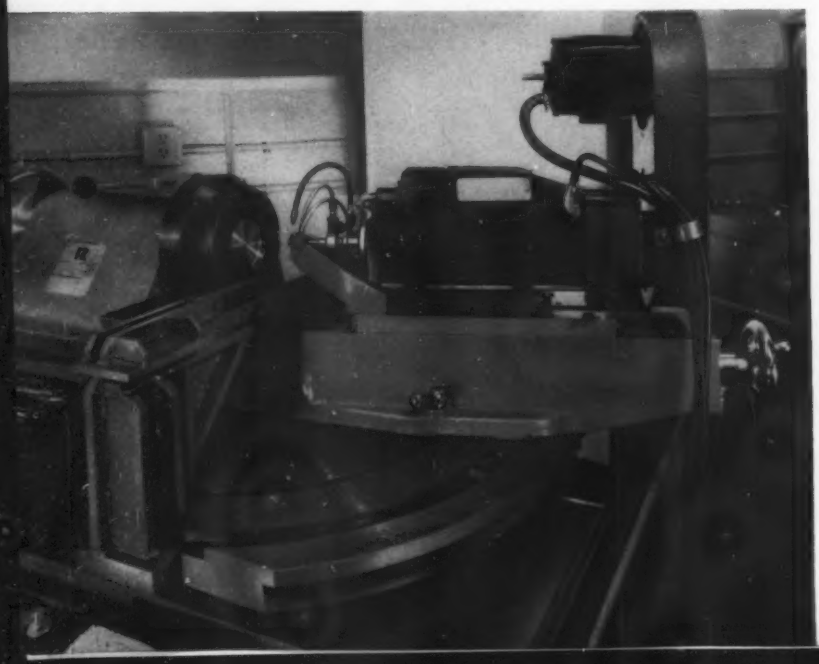

Fig. 2. Drilling machine which has the automatic spindle head mounted in a horizontal plane. The indexing fixture also turns on a horizontal axis.

Fig. 3. Drilling a hole at an angle on a machine similar to the one in Fig. 2 except for the head being mounted in a vertical plane.

speed of 16,800 rpm at full load. An electrical torque-reading instrument on the right-hand side of the column shows the actual speed of the drill at all times. If the speed falls off too greatly, it is an indication that the drill is becoming dull and requires resharpening.

The same type of automatic drill head is provided on the machine shown in Fig. 2, which is designed for drilling holes in horizontal planes, either parallel to the center line of the work or at specified angles. In this case, the work is mounted on a fixture that can be indexed around a horizontal axis. The fixture is mounted on a carriage that can be operated to move the fixture horizontally past the drill spindle for drilling at various radial points on the work. The fixture can also be moved in and out with respect to the work. Measuring bars provide for close settings of the two slides or carriages. This machine and the remaining machines to be described are all used on injector components for vernier engines.

Two machines similar in design to the one in Fig. 2, except that each drill head is mounted on a vertical surface of the column in such a manner that angular adjustments of the spindle are obtainable in a vertical plane, are shown in Figs. 3 and 4. On these machines, spots of different color are painted at the various index points on the work-fixture to facilitate successive setups of the work for the drilling steps. Two slides are provided for the turret-like indexing head for longitudinal and transverse positioning of the work. Measuring bars are also used to insure accurate settings. Drill torque is indicated by means of an electrical instrument as in the case of preceding machines described in this article.

Fig. 4. Another view of the machine in Fig. 3 showing the arrangement of the slides that enable longitudinal and transverse adjustment of the work-fixture.

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Furniture Nails Carried Through Progressive Die Automatically

ONE of the earliest examples of the use of mechanical fingers to advance individual work-pieces automatically through progressive dies appeared as early as 1900, in a battery of furniture and upholstery nail-making presses developed at the Hillwood Mfg. Co., Cleveland, Ohio. The principle, refined in the 1920's, remains basically unchanged today. Two men operate the entire nail-making department and a head-blanking press as well. Except for changing over for various lengths and styles of nails, the men need only replenish the wire coils, refill the head feed hoppers, and carry away the finished nails.

Furniture and upholstery nail shanks are made of cold-drawn Bessemer steel wire. Heads are either steel or brass. Steel heads are pierced from cold-rolled strip; brass ones, from 70-30 strip. The presses form the head, cut the wire shank to length, join the shank to the head, and pinch-trim the point. Afterwards, the nails are either nickel-plated, enameled, cadmium-plated, given a special finish, or left plain.

Each press contains a five-station progressive die, shown in the heading illustration. At the first station, the nail head is picked from a chute and preformed. At the second station, the incoming wire is headed slightly and then cut to length. At the third station, head and wire are joined, with the nail head slightly coined around the upset end of the shank. At the fourth station, the head coining is completed and the head is struck to final shape. At the fifth station, the point end of the shank is trimmed and the nail drops out of the press. Fig. 1 illustrates the work as it progresses through the five stations.

All heading punches and die buttons are Darwin & Milner high-carbon, high-chromium tool steel (PRK-33). This is an air-hardening grade containing cobalt, pack-hardened at 1850 degrees F. and soaked for one hour, then drawn at 385 degrees for two hours. The die buttons, an oil-hardening grade (Neor), are pack-hardened at 1740 degrees, then drawn at 500 degrees for two hours. The wire cutoff blades are high-speed steel. Based upon one shift per day, punch life is two to four weeks between grinds, die buttons run around six weeks, and cutoff blades run six to eight weeks. The feed fingers, casehardened cold-rolled steel, run six to eight weeks. Practically no breakage is experienced.

The presses are of straight-side design, modified to produce the additional movements explained diagrammatically in Fig. 2. A vertical take-off from the crankshaft is directed down one side of the press to cross shaft *A* through bevel gears *B*. The cross shaft in turn, through bevel gears *C*, rotates two cam-bars *D* in front of and behind the press. Cams *E* on the bars produce an in-and-out movement of the feed fingers *F*; similarly, cams *G* produce an in-and-out movement of the wire push-rods *H* and the point trim dies *J*. Left-to-right movement of the feed fingers is

Fig. 1. (Right) The nails are formed in five steps. Head blank is partly formed at Station 1, shank is upset and cut to length at Station 2, heads and shanks are joined and head formed at Stations 3 and 4, and point is trimmed at Station 5.

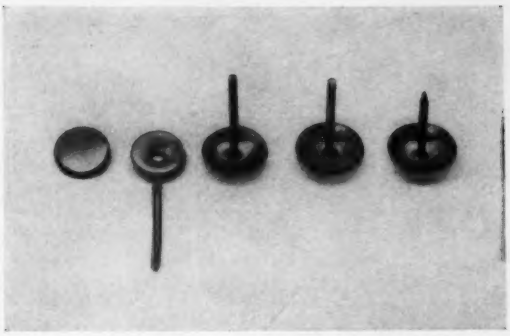


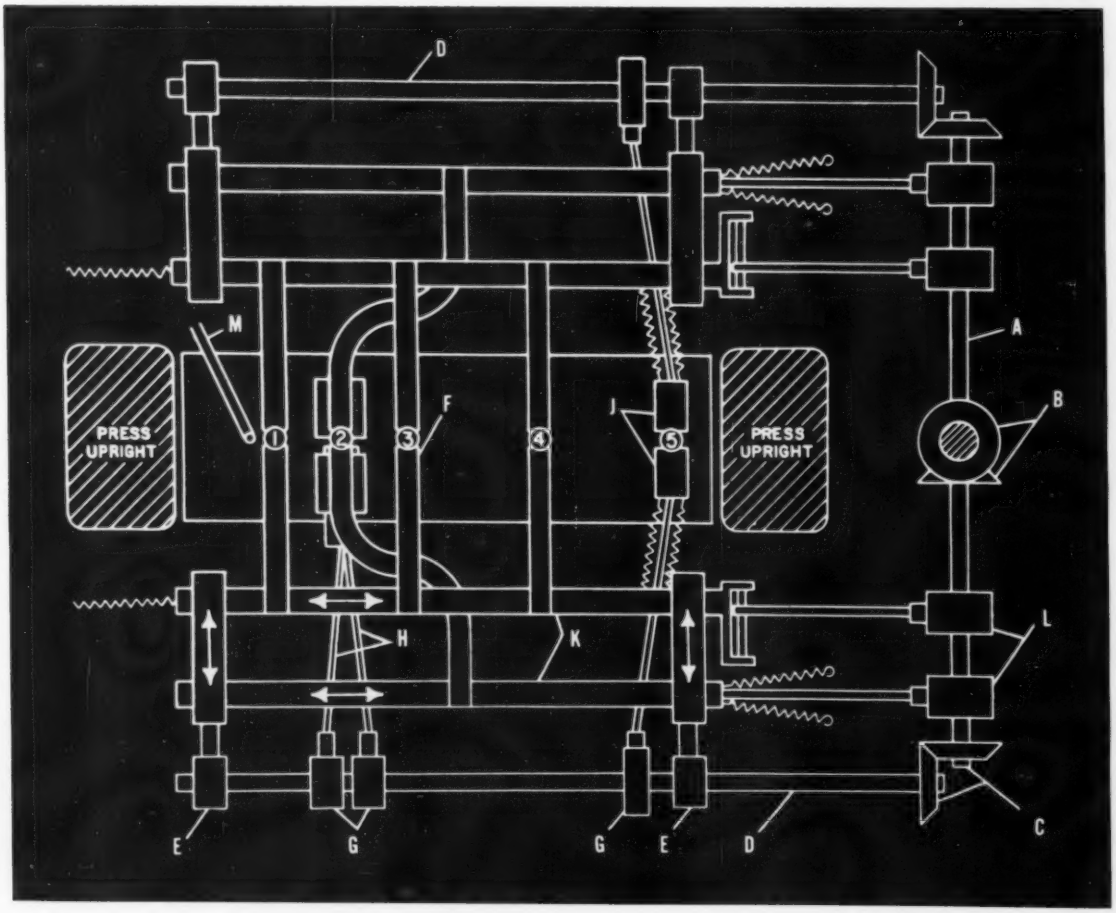
Fig. 2. (Below) Diagram of the shafts and cams which impart the additional movements for the automatic operation of the press.

provided by carrier *K* under the direction of cams *L* on the cross shaft.

Cross-sections of the die stations appear in Fig. 3. At Station 1 nail-head blank drops down a tube (*M* in Fig. 2) from a hopper feed. A die, carried in the press ram, wraps the head partly around a punch, forming a definite socket. As the ram ascends, a stripper surrounding the punch thrusts the head up. The head is then picked up by feed fingers and carried over to Station 3.

At Station 2 there are two cutoff blades and two holding fingers—one stationary and one movable of each. The moving cutoff blade, which is situated over the stationary blade, and the moving holding finger are both on the same side of the die. Two feed fingers for carrying the nail shank to Station 3 are situated above the holding fingers.

Underneath the press is a cam-operated, ratchet type device which feeds the wire vertically upward into Station 2. As the ram starts downward, the moving cutoff blade and holding finger are away from the wire. The wire feeds upward until it is approximately 1/16 inch above the holding fingers. Then the moving holding finger ad-



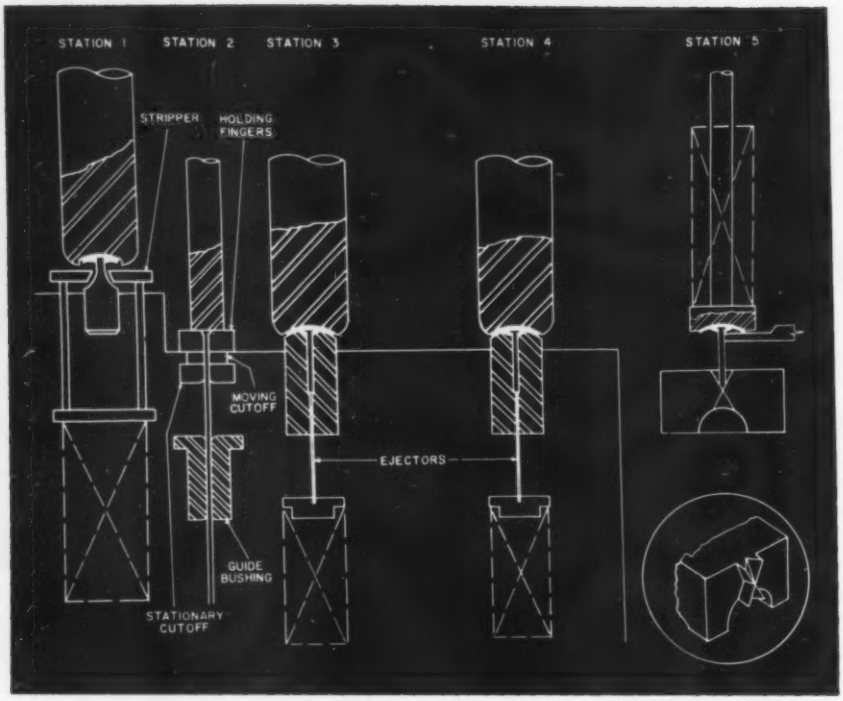


Fig. 3. (Left) Arrangement of the stations, punches, and die buttons. Inset at lower right shows end of the point trim punch.

Fig. 4. (Below) Punch for Station 4, and ornamental nails. Punch cavity is rough-machined, then cold-hubbed to provide sharp surface detail.

vances and clamps the wire in place, and the punch strikes and upsets the end of the wire.

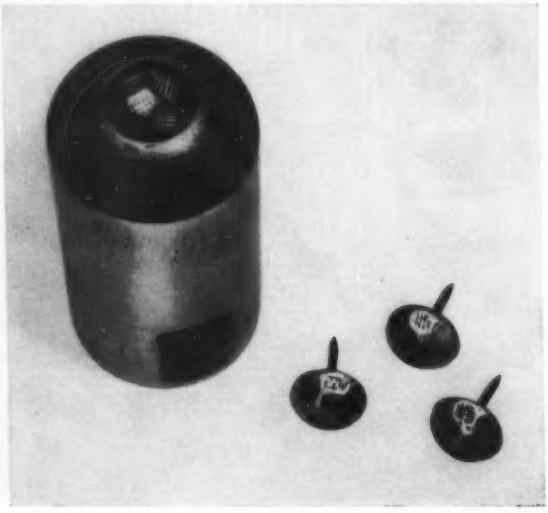
While the ram ascends, the moving cutoff blade is still back and the moving holding finger retracts. The wire is then fed up to its proper height and grasped by the feed fingers as the cutoff blade snaps it off. After the cutoff blade next retracts, the wire-feed fingers carry the cut-to-length shank to Station 3. The wire is moved only one-half as far as the feed fingers move the head and the nails between the other stations.

When the shank reaches Station 3, it is aligned with the hole in a die button in the lower part of the die. At the same time, another pair of feed fingers picks up a formed head from Station 1 and locates it over the shank. The fingers which hold the head are spring-loaded to pivot in a vertical plane.

As the ram descends, the punch forces the head and the fingers downward until the head makes contact with the shank, which is started in the hole in the die button. The feed fingers snap back out of the way, and the punch continues to descend until the shank strikes a shoulder inside the die button. The punch then partly coins the head around the upset end of the shank.

As the ram ascends, a tiny ejection device forces the nail head and shank assembly up out of the die button, where the nail is grasped by the feed fingers and carried to Station 4. There, a similar operation occurs: The coining is completed and the final form is imparted to the head. In the case of ornamental nails, the punch at Station 4 has a hubbed cavity, as can be seen in Fig. 4. The feed fingers carry the completed part to Station 5.

At Station 5 a spring-loaded holding punch mounted on the ram catches the edge of the nail head on a stationary finger mounted on the die. This holds the nail while the feed fingers move back out of the way and two trim punches strike and pinch the nail to a four-sided or conical point. On the up stroke, the punch releases the nail and it drops through a tube and out of the press.



Condensed Review of Some Recently Developed Materials

Arranged Alphabetically by Trade Names

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Sheet Steel Alloy	**Airsteel**	An air-hardenable, high-strength alloy sheet steel that is easily formed, cut, or shaped to a desired form and is weldable.	Uses include missile and rocket-motor cases.
Structural Aluminum	**Alcan B51S**	This extrusion ingot offers capability of a high extrusion speed, good mechanical properties, and a good finish.	Used for applications such as railings, decking, masts, and brackets and structural members.
Aluminum Casting Alloy	**Alcoa Alloy X250-T4**	A ductile, high-strength, aluminum sand-casting alloy that exhibits a high resistance to stress corrosion and retains ductility during natural aging.	Developed for aircraft structures, construction or mechanical equipment subject to impact loads, and equipment for the dairy, food, and chemical industries.
Aluminum Sheet Alloy	**Alcoa Alloy X5457**	An aluminum sheet alloy with a super-bright anodized finish.	This alloy, with its lustrous, mirror-like appearance, is particularly adaptable to the automotive and appliance industries.
Die Steel	**Alidie**	An air-hardening, high-carbon chromium die steel which is easy to machine and heat-treat and can hold a sharp edge over long periods of time.	Used in blanking and punching operations on knife blades and other cutlery.
Spring Wire	**Alloy HS25**	This spring wire has a tensile strength in the neighborhood of 220,000 psi, an elongation range from 4 to 8 per cent, and is non-magnetic.	For forming springs designed to operate at temperatures from 400 to 1400 degrees F.
Aluminum Alloy	**Alloy 357**	In the T-6 form it has a tensile strength of 48,000 to 50,000 psi and an elongation of 6 to 10 per cent.	Used where high tensile and yield strengths with high elongations and good castability are required.
Work-Holding Devices	**AlSiMag and Grade A Lava**	These custom-made jigs, fixtures, support rings, and work-holding devices are made of ceramics, with good thermal-shock resistance and dimensional stability.	These devices facilitate induction heating, brazing, welding, soldering, and other processes involving high temperatures.
Manganese-Bronze Alloy	**Ampcoloy 666**	This extruded manganese-bronze alloy has good bearing characteristics, good machinability, and a high resistance to wear and corrosion.	It is used in automatic machines for making long-wearing bushings, gears, cams, shafts, and connecting-rods.
Rust Preventive	**Anarust Types B, G, D, and S**	Types B and G are additives that leave a film on parts being cleaned that prevents oxidation. D and S are applied after the cleaning and finishing operation and must be removed before painting or plating.	Type B used in finishing ferrous metals. Type G used to clean certain types of aluminum. Type D used for parts finished in batches. Type S used on machinery and parts that may stand idle for prolonged periods.

For names and addresses of manufacturers of products listed, see end of this section

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Stainless Steel	**Armco 22-4-9**	A strong, hard, erosion-, oxidation-, and corrosion-resistant material for service at temperatures of 900 to 1600 degrees F.	Can be welded without preheating or postheating and is not susceptible to cracking. Used for making high-temperature steam valves and gas-turbine parts.
Stainless-Steel Honeycomb	**Avcomb**	The material consists of hexagon steel cells with a thin sheet of stainless steel brazed on both sides. It weighs about a tenth as much as a piece of stainless steel of the same thickness.	Used in high-speed aircraft and missiles. Can be made in various shapes to fit the contours of any surface.
Tool Steel	**Badger**	A flat-ground, oil-hardening tool steel ground 0.014 to 0.016 inch oversize on the thickness dimension. It contains tungsten and chromium.	Ideal for wear-resistance applications such as blanking dies, punches, cold-forming dies, gages, jigs, fixtures, templates, and machine parts.
Stain Remover	**BanZoil**	This noncaustic cleaner penetrates into stained concrete or brick and floats out grease, oil, and petroleum products in about sixty seconds.	Removes grease and oil stains from driveways, garage floors, and sidewalks.
Bonding Process	**Brazeez**	Provides a surface on carbide blanks that improves bonding. Makes brazing easier and faster and eliminates the cleaning previously required.	Speeds the brazing of carbides in the fabrication of carbide-tipped tools.
Nickel-Silver Alloy	**Bridgeport Nickel-Silver Alloy Wires**	These two nickel-silver alloys have excellent cold-working properties and are readily formed, bent, or cold-headed.	Capable of being joined by soft soldering, silver-alloy brazing, and resistance or oxy-acetylene welding, these wires are used for screws and rivets, slide fasteners, and optical parts.
Steel Bars	**Bright-Drawn**	These are standard cold-drawn steel bars that are bright.	Used for the machining of precision parts.
Tungsten Carbide	**CA-604**	This material exhibits high strength at high cutting temperatures. It has a long wear life and is highly crater resistant.	Its use in "Indexable" blanks facilitates high-velocity finishing with light to medium feeds.
Coolant	**Campbellene**	This cool-blue coolant concrete containing a deodorant keeps abrasive wheels clean and sharp, promotes rapid chip-settling, and minimizes odors.	Formulated for use with abrasive cutting machines and most grinding operations.
Steel Alloy	**Carpenter 404 Alloy**	An air-hardening, weldable, and fully martensitic alloy that can be used for highly stressed parts at temperatures up to 1050 degrees F.	Uses include steam-turbine buckets, blades, and bucket covers, as well as "casting in" assemblies, such as turbine diaphragms.
Epoxy Adhesive	**Cepox 401 Cepox 402**	These two high-strength epoxy bonding agents which are thermosetting produce a tough, water-insoluble bond that resists most acids, alkalies, and other chemicals.	For cementing cast iron, steel, copper, aluminum, bronze, brass, plastics, and other materials to themselves and to each other.
Preplated Steel	**C-Grade Steel Base**	A low-cost utility grade of steel with preplated finishes of chromium, nickel, and copper on a steel base which requires no cleaning, plating, or polishing.	Adaptable to standard production techniques such as stamping, blanking, bending, and welding without damage to the preplated finish.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Synthetic Chamois	**Chamie-Tex**	This synthetic chamois can be used in gasoline, kerosene, and other harsh industrial solvents. It may be washed in any soap or detergent.	For all wiping and cleaning jobs where natural chamois can be used—also for cleaning greasy machinery.
Aluminum Tube	**Chase General-Purpose Seamless Aluminum Tube**	This tube, produced in many diameters and wall thicknesses, is made from a soft-temper 3003 aluminum alloy. It flares easily, by either manual or mechanical means, and uncoils readily for cutting or straightening.	It has many applications in appliances, refrigeration, and automotive work, and similar technical and industrial uses where a light, strong, easily handled tube is necessary.
Copper Alloy	**Chase Silnic Bronze**	This corrosion-resistant nickel-silicon bronze alloy has both a high yield and a high tensile strength even at elevated temperatures. It is age-hardenable and is available in many tempers.	It is available in a variety of cross-sections and dimensions in straight lengths of rod and bar and coils of round, rectangular, and square-rolled and drawn wire.
Chromium-Plating Process	**Chrom-Lume**	This process plates chromium directly to aluminum, providing a surface which is hard, oxidation resistant, and which withstands chipping, peeling, cracking, and flaking.	Uses include the plating of fasteners, gears, pumps, valves, flow-control devices, and pulleys.
Protective Coating	**CMS-N-202**	A black coating for masking metal surfaces. It may be applied by brushing, spraying, or dipping and can be easily removed.	For the protection of machine and polished surfaces during pickling and passivating operations.
Coolant	**Cold Stream**	It is a water-soluble, metalworking coolant that stops rust, resists rancidity, reduces the causes of dermatitis, and is low-foaming.	Can be used on all types of metal machining, including grinding and threading.
Hard-Facing Powder	**Colmonoy No. 75**	This nickel-base, hard-facing powder contains tungsten carbide and chromium boride. The hard-faced surface is impact, oxidation, and corrosion resistant.	Applications include cylindrical parts, shaft sleeves, pump components, bushings, buffing fixtures, steadyrest jaws, and chip-breakers for cutting tools.
Copper-Clad Phenolite	**Copper-Clad Phenolite Grade G-11-861-1**	It has a bond strength of 10 to 15 psi, a dip-solder resistance greater than 30 seconds at 500 degrees F., good arc resistance, and is dimensionally stable.	For printed circuits such as military electronic circuits in rockets, missiles, and computers.
Barrel-Finishing Process	**Cor-A-Brite**	Process permits a reduction of finish in micro-inches from 10 rms to 2 rms in a 10-hour finishing cycle.	Process employs only one chip mass in a standard barrel-finishing machine. It is used on high-alloy steel bearings.
Sintered Nickel	**Cormet A**	This porous sintered nickel can be produced in a variety of shapes.	Used as polished burner rings, rollers, and chuting material.
Surface Coating	**CRC 3-36**	For long-term protection of metal surfaces of iron, steel, aluminum, magnesium, and plated finishes.	Is used on precision equipment, surfaces, castings, and raw-material stocks.
Adhesive Sealant	**Cycleweld Liquid Iron**	This adhesive and sealer dries in air without heat or pressure, is durable, nonshrinking, and will withstand mild acids and alkalies.	This putty-like synthetic plastic sets into a substance like iron and will bond metals and nonmetals.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Plastic Metal	Devcon F-2	This material has a compressive strength of 20,000 psi and is unaffected by most oils, chemicals, and solvents. It can be drilled, tapped, or otherwise machined with metal-working tools.	Used to fill large and small blow-holes in castings, to fill holes which have been drilled incorrectly, and to build up worn sections of cast or machined parts.
Drafting Medium	Dietzgen Ageproof Film	This drafting material withstands considerable usage such as repeated erasures, folding, and handling. It is fungus-resistant and is not stained by perspiration or water.	The film is available with a plain surface and with a diazo- and phototype-sensitized surface for drafting uses.
Magnesium Anodize	Dow 17-40 Volt	This anodize is used under a lacquer or varnish and may be tinted with commercial dyestuffs. The resulting colors have good permanence and are not washed out by detergents.	May be applied to all forms of magnesium, such as sheet, extrusions, die-castings, sand castings, and forgings.
Cutting Fluid	Dromus Oil E	Used in a ratio of one part oil to twenty parts water, the mixture acts as a coolant and at the same time protects carbide tools against breakage resulting from thermal shock.	For high-speed production equipment use in the aircraft, missile, automotive, and heavy-machine industries.
Bearing Material	DU	This thin lining of spherical bronze, impregnated with a mixture of Teflon and 20 per cent lead, is sintered to a steel backing.	Available in strip form, from which bushings can be made, thrust washers cut, or hemispherical bearings pressed.
Metal Coating	Dunal	This metal coating will not crack under extreme pressure or heat. It is not affected by alkalies and acids and can withstand impact.	Facilitates the production of precision parts of refrigerators, pumps, washing machines, automobiles, and aircraft.
Alloy Steel	Dynaflex	An air-hardening specialty steel possessing high strength at elevated temperatures. It is easily formed, worked, and welded.	Steel is furnished in billets, bars, forgings, and special shapes. Applications include structural parts for jet aircraft.
Rare-Earth Alloy	EK31XA	This alloy, containing magnesium and a rare-earth metal, has good castability, can be welded by the argon-arc or Heliarc methods, and can be finished with standard magnesium finishing systems.	For making sand castings that have good tensile strength at room temperature and at temperatures up to 600 degrees F.
Corrosion Preventive	Entek 45	This liquid additive to hot-water rinses prevents spotting and subsequent corrosion of metals.	Used in rinses after plating, pickling, or chemical processing of any kind.
Epoxy Resin	Epocast 28	This resin requires a relatively short cure, has good electrical properties, a low dielectric constant, and is particularly suited to laminating of glass fibers.	Has been used for structural laminations and for electrical insulating purposes.
Epoxy Adhesives	EPY-150 EPY-400	These epoxy cements have a maximum service temperature of 150 degrees F. and 400 degrees F., respectively.	Formulated specifically for use with bonded-filament strain gages.
Drawing Lubricant	EverLube T-50	The material is applied to the sheet and allowed to dry. After the metal-forming operation it may be removed with a hot caustic dip or solvent cleaner.	For the hot-forming of sheet metal such as titanium.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Sintered Tungsten	**Firth Sterling Forgeable Sintered Tungsten**	These readily forgeable sintered tungsten and tungsten-alloy billets contain equal amounts of tungsten and molybdenum and have a melting point of close to 5300 degrees F.	For components in jet aircraft frames and engines, and missiles and space vehicles, as well as for radiation shielding, counterweights, and gyro rotors.
Silver-Brazing Alloy	**Fluxless Nu-Braze No. 0070**	A lithium-containing, silver-brazing alloy that will join such metals as precipitation-hardening stainless steels and other high-temperature aircraft steels.	Used for such structural parts operating in temperatures up to 900 degrees F. as aircraft honeycomb structures and heat exchangers.
Die-Metal Alloy	**Formaloy**	This high-strength, zinc-base die-metal alloy has high impact strength. It is readily workable and no special techniques are required for casting or machining.	Applications include drop-hammer punches and dies, draw-press dies, stretch-press dies, blanking dies, and punch-press fixtures.
Textured Finish	**Fro-Zon**	This textured finish for stainless steel is put on very lightly. It does not penetrate the surface and diffuses the light rays to give a frosted effect.	Applied after the steel is formed, it is used on automobile-trim sections.
Columbium-Treated Steels	**GLX-45-W GLX-50-W GLX-55-W GLX-60-W**	These steels, identified by means of their yield strengths, "45" meaning 45,000 psi minimum yield strength, have a typical ultimate tensile strength ranging from 70,000 to 82,000 psi.	They are readily weldable and formable and are used in the fabrication of truck trailers, loading devices, railroad cars, steel flooring, pipeline, and formed sheets.
Aluminum Bar Stock	**Harvey Aluminum Bar Stock**	The availability of deep-drawn aluminum machining stock in large sizes (up to 4 inches) has been announced.	This bar stock, which includes 2011, 2014, 2017, 2024, 6061, and 6066, provides a surface that for ordinary applications requires no supplementary finishing.
Aluminum Shapes	**Harvey Aluminum Shapes**	These shapes include tube, integrally stiffened panels, stepped extrusions, and structural sections such as I-beams, H-beams, channels, angles, tees and zees, bar, rod, semihollow shapes, etc.	Used as structural components for transportation equipment, building and architectural sections, bridges, aircraft and missiles, and as tubes for atomic-energy installations.
Nickel-Base Alloy	**Hastelloy Alloy N**	The product has good weldability, can be readily forged, and can be extruded to form seamless tubing.	Has been used as a container material for molten fluoride salts.
Epoxy Resin	**Hysol 6251**	A conductive coating based on epoxy resins which has a low volume resistivity, good toughness, and good adhesion.	For rebuilding areas worn away by sliding contacts and to serve as a conductive base for plating plastics.
Hardening Bath	**Hy-Speed Case**	This surface-hardening bath gives great wear resistance and surface hardness to alloys after they have been hardened, tempered, and ground.	For the surface hardening of high-speed cutting tools.
Epoxy Adhesive	**Isobond 331**	A one-part 100 per cent epoxy adhesive that cures at moderate temperatures and requires no mixing or metering.	Designed for high-speed production use to bond metals, glass, ceramics, and most plastics.
Bar Steel	**Jalcase 100**	A high-strength, stress-stabilized, free-machining, cold-finished bar steel.	Use of this steel in the production of wear-resistant parts eliminates the need, in most cases, for heat-treatment.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Enamel Paint	Jet-Dri	Quick-drying enamel that permits use of surfaces fifteen minutes after painting.	Will produce a smooth, even-textured coating over concrete, metal, and wood surfaces.
Marking Material	Kemifilm No. 27	This product is a blue steel-marking coating which will remain moist. It is water soluble and nontoxic.	Replaces Prussian blue for spotting dies, punches, and round and flat bearing surfaces.
Hard-Surfacing Powder	Kenspray	This powder produces a hard surface that possesses properties resembling those of Kennametal's cemented tungsten carbides. Treated surfaces cannot be machined but must be ground.	The powder is applied to steel parts by well-known metal spraying techniques. Both irregular shapes and flat surfaces can be coated easily.
Coolant	Keystone 106	This high-detergent, water-soluble coolant contains no oils and forms a true chemical solution. It is rust-inhibiting, odorless, smokeless, and harmless to the skin.	This nonflammable cutting coolant, when used with saw blades, arrests wear and promotes creation of clean edges.
Magnet Material	Koroseal Vinyl Plastic Magnet	This flexible material, compounded and processed to act exactly like metal or ceramic magnets, can be extruded into various shapes.	It is adaptable for best pole location, since it is capable of being magnetized with multiple poles by spot-magnetization.
Brazing Flux	Kwikflux 490	This silver-brazing flux with good heating tolerance and good coverage per pound of material has a smooth consistency for ease of application.	Adapted to automatic or semi-automatic brazing operations in a temperature range of from 1100 to 1700 degrees F.
Alloy Steel	Lapelloy C	This high-temperature alloy has a homogeneous structure with a uniform fabrication behavior and uniform mechanical properties.	Applications include such jet-engine parts as compressor wheels, turbine shafts, compressor buckets, blades, and bolts.
Tubing	Ledloy 170	A leaded steel tubing which may be cut with an average cutting speed of 170 sfpm.	Available from warehouse stocks as a cold-drawn, seamless steel tubing of low-carbon analysis.
Die Steel	Lo-Air	This low-temperature, air-hardening tool steel is easy to machine and has good fatigue properties.	Available in flats, squares, rounds, and billets for tool and die applications.
Liquid Sealant	Loctite	This thin, liquid, plastic sealant hardens only when confined between closely fitting metal parts.	For retaining bearings in housings, to lock nuts and bolts, and to seal threaded and sleeve joints.
Aluminum Casting Alloy	MA-356	This high-purity alloy is a variant of A-356 alloy and is highly responsive to heat-treatment.	Used for castings for missiles and high-performance aircraft.
Welding Alloy	Mallory 28 Metal	It has high electrical and thermal conductivity coupled with high strength and hardness.	Recommended where resistance to annealing is required and for resistance welding where checking and cracking is a problem.
Welding Electrode	Mangjet	It is a low-hydrogen, iron-powder electrode that has a high deposit rate and gives smooth beads and a steady arc.	The electrode is suitable for building up manganese-steel hard-surfacing deposits on either manganese or carbon steels and also for making sound joints between manganese and carbon-steel parts.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Epoxy Resin	**Maraglas Resin No. 655**	This transparent plastic is an easily cast thermosetting material which provides 90 per cent light transmission, does not discolor, and has low shrinkage.	Uses include the making of models, prototypes, machine housings, lighting fixtures, panels, and structural parts.
Wear-Strip Material	**Meier Wearite**	The material, containing aluminum and bronze, has a smooth surface, fine wear characteristics, and is easily machined. It is corrosion and fatigue resistant.	Used as wear plates, slides, and gibs in the making and maintaining of machines.
Hard-Facing Powder	**Metco Tungsten-Carbide ThermoSpray Powders**	These tungsten-carbide spray-powder materials are torch-fused after being deposited. Any required coating thickness may be applied.	Applications include parts subject to extreme wear conditions such as buffing fixtures, sanding templates, polishing masks, tool joints, and metal patterns.
Plating Decontaminant	**Metex Non-Pitter N-17**	This liquid can restore brightness to dull, blotchy deposits caused by organic contamination of bright baths.	Used to overcome the effects of organic contamination in copper-cyanide plating baths which are not air-agitated.
Tungsten-Carbide Powders	**Mikrocarbide**	These sintered tungsten-carbide powders are for hard surfacing, abrasives, diamond settings, plastic dies, and other applications where a hard, wear-resistant material is required.	May be used for making hard-surfacing welding rods, coatings for cutting tools for stone, earth, concrete, and masonry. Can be used for making sanding blocks, abrasive wheels, and polishing powders.
Sandwich Core	**Multiwave**	An aluminum sandwich-core material which has good formability and may be draped over the most complex molds or shapes.	Has been adapted to making production tools including welding jigs, holding fixtures, and large molds for forming plastic and thin-gage metal parts.
Graphite Textiles	**National Carbon Graphite Textiles**	These graphite textiles, which have a purity of 99.9 per cent, are resistant to attack by acids, alkalies, and organic compounds except those of a highly oxidizing nature, and are unreactive with many molten metals.	Available in four weaves, it is available for applications that require good lubricating properties, and a tensile strength of 10 to 15 pounds per inch of width at room temperature.
Brazing Alloy	**Nicrobraz No. 170**	A nickel-chromium-boron brazing alloy which is applicable to most "super alloys." Produces high-strength joints for steady service at temperatures up to 2000 degrees F.	Available as a powder, it will satisfactorily braze tungsten and molybdenum bearing alloys.
Brazing Stop-Off	**Nicrobraz Red Stop-Off**	An easy-to-remove material for controlling the flow of brazing alloys during furnace processing. Acts as a barrier to the molten alloys by preventing capillary action.	Used on parts having small internal holes, fine threads, and similar delicate details which must be perfectly clean after brazing.
Degreasing Agent	**No-Tox**	This degreasing agent has characteristics similar to carbon tetrachloride, is completely safe, and has low toxicity.	Can be used in any type of degreasing operation with the exception of vapor-phase degreasing.
Silicone Rubbers	**NSR-X5602 NSR-X8701 NSR-X4803**	NSR-X5602 has intermediate fluid resistance and is intended for intermittent contact with high-swell fluids or continuous immersion in milder fluids. NSR-X8701 features high-temperature oil resistance. NSR-X4803 has intermediate resistance to high-temperature fluids.	NSR-X5602 used as airframe seals, diaphragms, and shock mounts. NSR-X8701 and NSR-X4803 are suitable for O-rings, gaskets, and oil seals.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Drawing Lubricant	No. 700 Wax-Draw	The product lubricates up to temperatures of 450 degrees F. and at pressures up to 200,000 psi.	For deep-drawing operations coated blanks may be drawn either wet or dry. The coating process can be easily adapted to continuous press operations.
Nylon Air Hose	Nycoil Hose	A tough, lightweight nylon air hose that is said to be heat resistant and unaffected by oil, kerosene, or gasoline.	Recommended as a general-purpose air hose for industrial plant and machine shop lubrication rooms.
Cleaning Agent	Oakite Compound No. 86	This acidic detergent combines good cleaning and prepaint-conditioning properties. It cleans steel, brass, aluminum, zinc, and terne plate.	Used in spray-washing machines and for tank-immersion operations.
Paint-Stripper Additive	Oakite Stripper Additive No. 4	This new additive is designed to enable alkaline paint-stripping solutions to be effective on difficult-to-remove finishes.	For removing epoxy, acrylic, and other similar tough finishes, as well as paint build-ups from equipment.
Mounting Pads	PadZorbers	These two types of Neoprene mounting pads for isolating vibration, preventing machinery travel, and deadening noise have deep, rugged cross-ribs molded on each side.	May be cut to any shape to fit under the feet of punch presses, drill presses, lathes, etc.
Programming Tape	Peerless	This extremely thin, high-strength, vulcanized-fiber tape combines high tensile and bending strength with flexibility.	For use on tape-control fed automatic programming equipment. It has an estimated maximum life of 1,000,000 cycles.
Stainless Steels	PH55A PH55B PH55C	These 18-8 type stainless alloys have high strength and resistance to pitting.	For applications where pitting, stress, and shock are a problem and where corrosion resistance is required.
Bonding Process	Plymet	Process produces shock-resistant joints with rupture strengths of from 100,000 to 135,000 psi.	Can be used to attach carbide tips to blanking punches, molding punches, turning tools, drills, and other tools.
Polycarbonate Resin	Polypenco	The product has a high impact strength, a high heat resistance, dimensional stability, and good electrical properties.	For producing rod, tube, plate, and discs. Can be fabricated into close-tolerance finished parts.
Tool Steel	Ready Mark	An air-hardening, precision-ground tool steel that is precolored maroon to eliminate the cleaning, coloring, and drying required for marking ordinary flat stock.	This air-hardening stock is recommended for dies, gages, machine parts, shear blades, knurling tools, taps, and similar items.
Nickel Alloy	Rene 41	This alloy exhibits good resistance to oxidation and has an ultimate tensile strength ranging from 180,000 psi at 1000 degrees F. to 35,000 psi at 1800 degrees F.	Used in a temperature range of from 1200 to 1800 degrees F. It may be drawn, bent, or conventionally shaped.
Hard-Facing Alloy	Rexweld 66	This hard-facing welding alloy is highly resistant to thermal shock and impact and compressive loads at high temperatures. It will not chip or spall under severe service.	For applying hard facing to drop-hammer forging dies.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Marking Ink	**Reynolds Ink**	This ink, available in nine colors, dries instantly, will not rub off, and may be easily removed with toluol, benzol, alcohol, or lacquer thinner.	Useful for the color-coding of tool steels.
Flat Ground Stock	**Royal Precision-Ground Low-Carbon Steel**	This stock is easily machined and welded and is obtained in standard 24-inch lengths, packaged in rust-inhibiting envelopes.	A fine-finished steel for applications not requiring heat-treatment other than casehardening.
Rust Preventive	**Rust Veto 377**	This film is not removed by ordinary handling. Treated parts do not have to be cleaned before lubricating.	For the protection of metal parts to be stored indoors for long periods.
Die Steel	**Sagamore-EZ**	This 5 per cent chromium, air-hardening die steel with uniformly distributed sulphide particles for free-machining is tough and wear resistant.	For uses where toughness and wear resistance are required, such as in dies, rolls, and blanking and forming punches, trimmer dies, etc.
Polishing Material	**Scotch-Brite**	A material for finishing fabricated metals that is made of nylon web impregnated with fine grades of abrasive. It is not intended for stock removal.	Used in finishing stainless steel, aluminum, zinc, brass, copper, titanium, and other non-ferrous metals.
Aluminum Sheet	**Spangle Sheet**	This sheet has an unusual glittering finish. It can be obtained plain and in color.	Used for automotive and appliance trim, lighting fixtures, gift ware, and interior decorations.
Silicone Grease	**SS-4007**	Maintains its consistency from −75 to +300 degrees F. It lubricates and is rust inhibiting.	Used as a rust inhibitor and lubricant on ferrous and lubricant on rubber parts.
Epoxy Stripper	**Stripper S-26**	This cold, chlorinated, liquid stripper for epoxy enamels is acidic in nature and nonflammable.	Used to remove epoxy coatings from most metals including steel, aluminum, copper, brass, and zinc die-castings.
Hydraulic Fluid	**Sunsafe**	A water-in-oil, emulsion type hydraulic fluid with fire-resistant properties; has a viscosity index of 130 and a good film strength at high temperatures.	May be used with all centrifugal, rotary, and reciprocating or piston type hydraulic pumps.
Spring Wire	**Superalloy Spring Wire**	An Inconel X spring wire that is heat-treatable and can be precipitation-hardened.	For components that operate between 650 and 1000 degrees F.
Reproduction Material	**Supertransline**	A low-cost emulsion and base for use in making positive intermediates and negatives. The product is printed by contact and can be handled safely in subdued light.	It is employed in the printing of engineering whiteprint intermediates and intermediates for diazo machines.
Lubricant	**Suspension 10**	A finely stabilized, natural colloidal-graphite lubricant for high-temperature, severe-load industrial use.	Used for forging, die-casting, forming, stamping, and drawing of aluminum, titanium, and other metals.
Lapping Compound	**Tetrabor Paste**	Ready-to-use compound of special oils and boron carbide, a material that closely resembles diamond in hardness and specific weight.	For lapping carbide dies and tools and polishing plastic molds.

Review of Some Recently Developed Materials—Continued

MATERIAL	TRADE NAME	PROPERTIES	APPLICATIONS
Teflon Tape	**Thred-Tape**	A pipe-joint sealer made in tape form used to seal all types of threaded connections in piping for most industrial acids, corrosives, caustics, hydraulic fluids, and aromatic fuels.	Useful on plastic, aluminum, stainless steel, ceramic, synthetic rubber, and carbon pipe, the tape prevents seizing and galling, is self-lubricating, and allows connections to be drawn up tight.
Tubing	**3 Al-2.5 V Titanium Alloy**	A ductile, high-strength titanium alloy in small tubing form that has a yield strength, in the annealed condition, of 85,600 psi.	Has applications in the aircraft- and missile-parts field where a metal having a high strength-to-weight ratio and corrosion resistance is required.
Brass Rod	**3 Mark Rod**	The product offers close tolerances in "off-the-shelf" length and straightness and also offers protection against feed-finger breakage due to the control of chamfer.	This free-cutting brass rod was developed for use in high-speed screw machines.
Flat Stock	**Thrift**	This low-carbon, steel flat stock for unhardened and casehardened use is precision ground to a satin finish of 35 microinches or better and has free machining characteristics.	Applicable to a variety of jig, fixture, tool, gage, and part-making jobs.
Stainless Steel	**Type 304L Stainless Steel**	This stainless steel contains 2 per cent boron and is produced by air-melting in electric-arc furnaces.	This material is of particular significance to the commercial atomic-energy field where it is used for nuclear-reactor control rods and as a shielding material.
Gasketing Material	**Uniphase Cork**	The material combines impermeability, conformability, and chemical inertness. It is fungus and ozone resistant.	Designed to eliminate seepage and leakage of fluids and gases.
Vinyl-Coated Steel	**USS Vinyl-Coated Steel Sheet**	This vinyl-coated steel sheet material may be fabricated in the same manner as cold-rolled sheet without damage.	Uses include automobile interiors, appliance cabinets, and architectural products.
Aluminum Alloy	**Vanasil**	This alloy has a coefficient of expansion of two millionths of an inch per inch more than cast iron.	Used to produce engine pistons and also pistons for refrigeration compressors.
Gasketing Material	**Viton**	This material, which is used for packings, seals, and gaskets, resists the attack of acids, bases, and many organic solvents and also has good resistance to compression sets.	This broad temperature-range polymer has proved successful in military aircraft and missile applications.
Steel-Cutting Carbides	**Wessonmetal HR Wessonmetal HV**	Grade HR, which does not crater or chip readily under interrupted cutting conditions, performs best at 250 to 450 fpm. Grade HV, which produces good surface finishes, performs best at 500 to 2000 fpm.	Bridges the gap between low-speed applications with severe impact and high-speed finishing cuts.
Aluminum Alloy	**X5557**	Material can be given lustrous anodized finishes and has good workability. The bright, chromium-like finish obtained after polishing, brightening, and anodizing has good resistance to corrosion.	Applications are largely in the automotive, appliance, and architectural fields.
Magnesium Alloy	**ZE10A**	This magnesium sheet and plate alloy does not require stress relief after welding.	Uses include missile shipping and storage containers and tank-trailer bodies.

Names and Addresses of Manufacturers of Products Listed

Airsteel—United States Steel Corpn., 525 William Penn Place, Pittsburgh 30, Pa.

Alcan B51S—Aluminium Limited, Inc., 620 Fifth Ave., New York 20, N. Y.

Alcoa Alloy X250-T4—Aluminum Company of America, Room 745, Alcoa Bldg., Pittsburgh 19, Pa.

Alcoa Alloy X5457—Aluminum Company of America, 730 Alcoa Bldg., Pittsburgh 19, Pa.

Alidie—H. K. Porter Co. Inc., Vulcan-Kidd Steel Division, Aliquippa, Pa.

Alloy HS25—National Standard Co., Niles, Mich.

Alloy 357—Reynolds Metals Co., Richmond 18, Va.

AlSiMag and Grade A Lava—American Lava Corpn., Cherokee Blvd. and Mfrs. Road, Chattanooga 5, Tenn.

Ampcoloy 666—Ampco Metal, Inc., 1745 S. 38th St., Milwaukee 46, Wis.

Anarust Types B, G, D, and S—Techline Division, Wheelabrator Corpn., 2400 Avenue V, Vicksburg, Mich.

Armco 22-4-9—Armco Steel Corpn., 1939 Armco Ave., Middletown, Ohio

Avcomb—Crosley Division, Avco Mfg. Corpn., 1329 Arlington St., Cincinnati, Ohio

Badger—Latrobe Steel Co., Latrobe, Pa.

BanZoil—Banzoil Co., 54 E. Delaware St., Chicago, Ill.

Brazeez—Research and Development Dept., National Twist Drill & Tool Co., Rochester, Mich.

Bridgeport Nickel-Silver Alloy Wires—Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.

Bright-Drawn—Jones & Laughlin Steel Corpn., 3 Gateway Center, Pittsburgh 30, Pa.

CA-604—Carmet Division, Allegheny Ludlum Steel Corpn., Ferndale, Mich.

Campbellene—Allison Campbell Division, American Chain & Cable Co. Inc., 929 Connecticut Ave., Bridgeport 2, Conn.

Carpenter 404 Alloy—Carpenter Steel Co., Reading, Pa.

Cepox 401 and 402—Chemical Development Corpn., Danvers, Mass.

C-grade Steel Base—American Nickeloid Co., Peru, Ill.

Chamie-Tex—Milwaukee Dustless Brush Co., 530 N. 22nd St., Milwaukee 3, Wis.

Chase General-Purpose Seamless Aluminum Tube—Chase Brass & Copper Co., Waterbury 20, Conn.

Chase Silnic Bronze—Chase Brass & Copper Co., Waterbury, Conn.

Chrom-Lume—Service Hard-Chromium Co., Route 22, Union, N. J.

CMS-N-202 – Consolidated American Services, Inc., 9999 Jefferson Blvd., Culver City, Calif.

Cold Stream—S. C. Johnson & Son, Inc., Racine, Wis.

Colmonoy No. 75—Wall Colmonoy Corpn., 19345 John R St., Detroit 3, Mich.

Copper-Clad Phenolite Grade G-11-861-1—National Vulcanized Fibre Co., Box 311, Wilmington, Del.

Cor-A-Brite—Roto-Finish Co., Kalamazoo, Mich.

Cormet A—Corning Glass Works, Corning, N. Y.

CRC 3-36—Corrosion Reaction Consultants, 116 Chestnut St., Philadelphia 6, Pa.

Cycleweld Liquid Iron – Cycleweld Chemical Products Division, Chrysler Corpn., Detroit 31, Mich.

Devcon F-2—Devcon Corpn., Danvers, Mass.

Dietzgen Ageproof Film—Eugene Dietzgen Co., Dept. M-2, 2425 N. Sheffield Ave., Chicago 14, Ill.

Dow 17-40 Volt—Dow Chemical Co., Midland, Mich.

Dromus Oil E—Shell Oil Co., 50 W. 50th St., New York 20, N. Y.

DU—United States Gasket Co., Camden, N. J.

Dunal—J. Landau & Co., Inc., Carlstadt, N. J.

Dynaflex—Latrobe Steel Co., Latrobe, Pa.

EK31XA—Dow Chemical Co., Midland, Mich.

Entek 45—Enthone, Inc., New Haven, Conn.

Epocast 28—Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif.

EPY-150 and EPY-400—Electronics & Instrumentation Division, Baldwin-Lima-Hamilton Corpn., 42 Fourth Ave., Waltham 54, Mass.

EverLube T-50—EverLube Corpn., 6940 Farmdale Ave., North Hollywood, Calif.

Firth Sterling Forgeable Sintered Tungsten—Firth Sterling, Inc., 3113 Forbes St., Pittsburgh 30, Pa.

Fluxless Nu-Braze No. 0070—American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

Formaloy—American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.

Fro-Zon—Stamping Service, Inc., 5500 Davison, Detroit, Mich.

GLX-45-W, GLX-50-W, GLX-55-W, and GLX-60-W—Great Lakes Steel Corpn., Ecorse, Mich.

Harvey Aluminum Bar Stock—Harvey Aluminum, 19200 S. Western Ave., Torrance, Calif.

Harvey Aluminum Shapes—Harvey Aluminum, 19200 S. Western Ave., Torrance, Calif.

Hastelloy Alloy N—Haynes Stellite Co., Union Carbide Corpn., 420 Lexington Ave., New York 17, N. Y.

Hysol 6251—Houghton Laboratories, Inc., Olean, N. Y.

Hy-Speed Case—A. F. Holden Co., 14349 Schaefer Highway 27, Detroit, Mich.

Isobond 331—Iso-chem Resins Corpn., 221 Oak St., Providence 9, R. I.

Jalcase 100—Jones & Laughlin Steel Corpn., 3 Gateway Center, Pittsburgh 30, Pa.

Jet-Dri—Consolidated Chemical & Paint Mfg. Co. Inc., 456 Driggs Ave., Brooklyn, N. Y.

Kemifilm No. 27—Wayne Chemical Products Co., 9250 Copland Ave., Detroit 17, Mich.

Review of Some Recently Developed Materials—Continued

Names and Addresses of Manufacturers of Products Listed

Kenspray—Kennametal Inc., Latrobe, Pa.

Keystone 106—Keystone Lubricating Co., 3100 N. 21st St., Philadelphia, Pa.

Koroseal Vinyl Plastic Magnet—B. F. Goodrich Industrial Products Co., Marietta, Ohio

Kwikflux 490 – Special Chemicals Corpn., 100 S. Water St., Ossining, N. Y.

Lapelloy C—Carpenter Steel Co., Reading, Pa.

Ledloy 170—Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill.

Lo-Air—Universal-Cyclops Steel Corpn., Bridgeville, Pa.

Loctite—American Sealants Co., Woodbine St., Hartford 6, Conn.

MA-356—Rolle Mfg. Co., 3rd and Cannon Aves., Lansdale, Pa.

Mallory 28 Metal—Metallurgical Division, P. R. Mallory & Co., Inc., Indianapolis 6, Ind.

Mangjet—Lincoln Electric Co., Cleveland 17, Ohio

Maraglas Resin No. 655—Marblette Corpn., 37-31 Thirtieth St., Long Island City 1, N. Y.

Meier Wearite—Meier Brass & Aluminum Co., 1471 E. Nine Mile Road, Hazel Park, Mich.

Metco Tungsten-Carbide ThermoSpray Powders—Metallizing Engineering Co., Inc., 1101 Prospect Ave., Westbury, N. Y.

Metex Non-Pitter N-17—MacDermid Inc., Waterbury, Conn.

Mikrocarbide—Shwayder Chemical Metallurgy Corpn., 684 E. Woodbridge, Detroit 26, Mich.

Multiwave—Narmco Resins & Coatings Co., 600 Victoria St., Costa Mesa, Calif.

National Carbon Graphite Textiles—National Carbon Co., Division of Union Carbide Corpn., 30 E. 42nd St., New York 17, N. Y.

Nicrobraz No 170—Stainless Processing Division, Wall Colmonoy Corpn., 19345 John R St., Detroit 3, Mich.

Nicrobraz Red Stop-Off—Stainless Processing Division, Wall Colmonoy Corpn., 19345 John R St., Detroit 3, Mich.

No-Tox – Electro-Chemical Products Corpn., 427 Bloomfield Ave., Montclair, N. J.

NSR-X5602, NSR-X8701, and NSR-X4803—General Electric Silicone Products Dept., Waterford, N. Y.

No. 700 Wax-Draw—S. C. Johnson Co. Inc., Racine, Wis.

Nycoil Hose—Nycoil Co., Westfield, N. J.

Oakite Compound No. 86—Oakite Products, Inc., 126 Rector St., New York 6, N. Y.

Oakite Stripper Additive No. 4—Oakite Products, Inc., 126 Rector St., New York 6, N. Y.

PadZorbers—T. R. Finn & Co, Inc., 200 Central Ave., Hawthorne, N. J.

Peerless—National Vulcanized Fibre Co., 1058 Beech St., Wilmington 99, Del.

PH55A, PH55B, and PH55C—Cooper Alloy Corpn., Hillside, N. J.

Plymet—Powder Alloys Corpn., 316 Colfax Ave., Clifton, N. J.

Polypenco—Polymer Corpn. of Pennsylvania, 2140 Fairmont Ave., Reading, Pa.

Ready Mark—Brown & Sharpe Mfg. Co., Industrial Products Division, Providence 1, R. I.

Rene 41—Cannon-Muskegon Corpn., 2875 Lincoln St., Muskegon, Mich.

Rexweld 66—Crucible Steel Company of America—Oliver Bldg., Pittsburgh, Pa.

Reynolds Ink—Reynolds Ink, Inc., 4500 Euclid Ave., Cleveland 3, Ohio

Royal Precision-Ground Low-Carbon Steel—Vanadium-Alloys Steel Co., Latrobe, Pa.

Rust Veto 377—E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

Sagamore-EZ—Allegheny Ludlum Steel Corpn., Henry W. Oliver Bldg., Pittsburgh 22, Pa.

Scotch-Brite—Minnesota Mining & Mfg. Co., Dept. F9-184, 900 Bush Ave., St. Paul 6, Minn.

Spangle Sheet—Aluminum Company of America, 757 Alcoa Bldg., Pittsburgh 19, Pa.

SS-4007—Silicone Products Dept., General Electric Co., Waterford, N. Y.

Stripper S-26—Enthone Inc., New Haven, Conn.

Sunsafe—Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

Superalloy Spring Wire – National-Standard Co., Niles, Mich.

Supertransline—Anken Chemical & Film Corpn., Newton, N. J.

Suspension 10—Joseph Dixon Crucible Co., Jersey City 3, N. J.

Tetrabor Paste—Titan Tool Supply Co. Inc., Box 3, 1419 Hertel Ave., Buffalo 16, N. Y.

Thred-Tape—Crane Packing Co., Dept. MY-3, 6400 Oakton St., Morton Grove, Ill.

3 Al-2.5 V Titanium Alloy—Superior Tube Co., Norristown, Pa.

3 Mark Rod—Chase Brass & Copper Co., Waterbury 20, Conn.

Thrift—Brown & Sharpe Mfg. Co., Industrial Products Division, 235 Promenade St., Providence 1, R. I.

Type 304L Stainless Steel—Carpenter Steel Co., Reading, Pa.

Uniphase Cork—Armstrong Cork Co., Lancaster, Pa.

USS Vinyl-Coated Steel Sheet—United States Steel Corpn., 525 William Penn Place, Pittsburgh 30, Pa.

Vanasil—Gillett & Eaton, Inc., Lake City, Minn.

Viton—Garlock Packing Co., 429 Main St., Palymyra, N. Y.

Wessonmetal HR and HV—Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

X5557—Aluminum Company of America, 763 Alcoa Bldg., Pittsburgh 19, Pa.

ZE1OA—Dow Chemical Co., Midland, Mich.

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for the best original articles describing mechanical movements

the rules

Both subscribers and non-subscribers are eligible. Entries must be *postmarked no later than December 1, 1959*. Mechanism or movement described must have some practical application. No material already described in the technical press can be entered in the contest.

Enter as many articles as you like, but confine each to a single mechanism or movement.

what you do

Send a scale drawing (or photograph—or both) that shows the operating principle and important parts involved. Clear blueprints or pencil drawings are acceptable, but free-hand sketches cannot be used.

Describe the *purpose* and *action* of the mechanism—*how* it does *what* it does. Your description need not be in polished English, but it should be clear and logical.

Mark details on drawing, such as levers, cams, and gears, with letters *A, B,* etc., and use corresponding letters to identify those details in the description; thus, "Lever *A* is operated by cam *B*." (A suggestion: See how articles in this issue's "Ingenious Mechanisms" section are handled.)

Substitute a diagram for the drawing, if necessary, to illustrate the arrangement of a complicated mechanism.

what we do

MACHINERY's editors review your entry—thoroughly and objectively—and evaluate it according to its ingenuity and originality. Award-winning articles will be announced in February (1960) MACHINERY.

ALL entries accepted will be published in forthcoming issues of the magazine.

And, of course, MACHINERY's high-level space rates will be paid to ALL CONTESTANTS, in addition to the seven cash awards.

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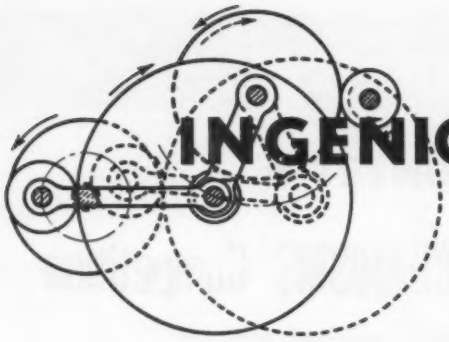


INGENIOUS MECHANISMS

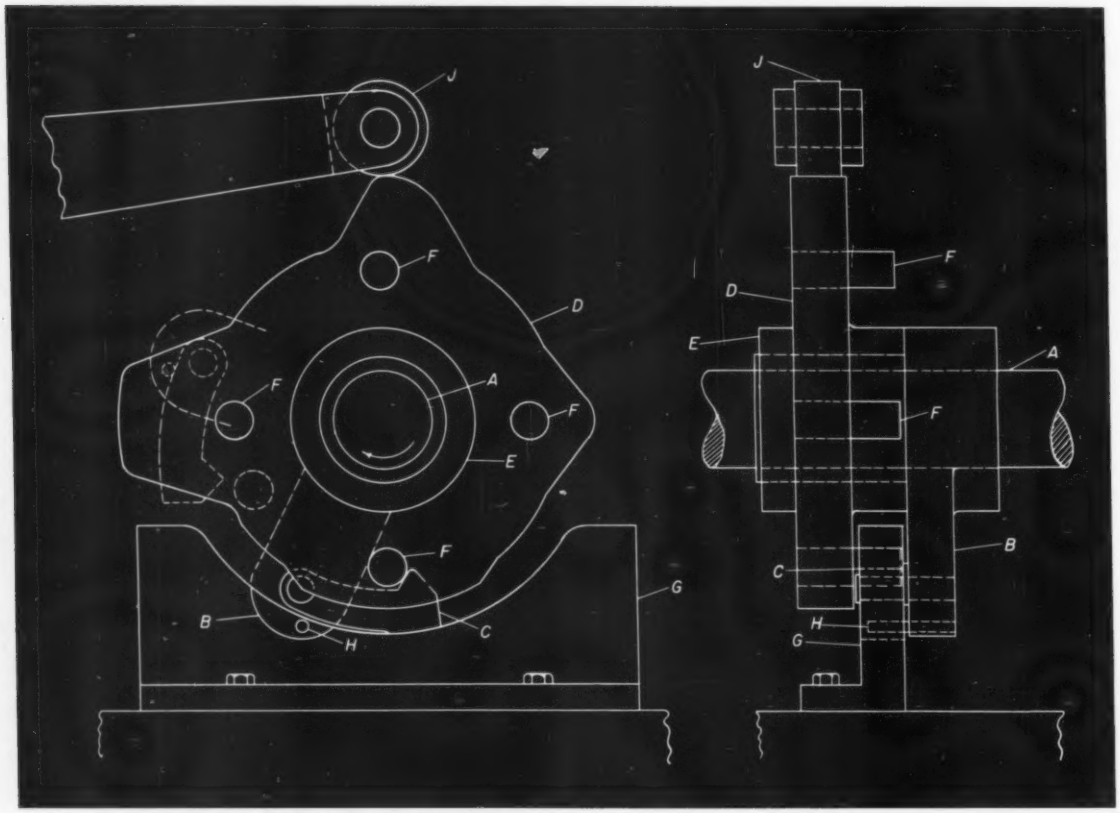
Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Four-Lobed Cam Transmits Variable Motion to Follower

L. KASPER, Philadelphia, Pa.

On a machine for fabricating a formed wire part, a revision in the product design required a change in a cam which operated a press. Previously, there had been a uniform oscillating motion of the follower with each revolution of the operating shaft. For the new design, it became necessary to transmit a motion of varying magnitude and varying timing for each of four revolutions of the shaft, without any major changes in the machine. The drawing shows the cam that was made to meet the requirements.

Operating shaft *A*, rotating in the direction indicated, carries arm *B*, which is keyed to it. On the arm is pawl *C*, which can swing on its stud. Four-lobed cam *D* is free on the extended hub of the arm, and is retained by collar *E*. Projecting



As long as pawl (C) remains in contact with angle-plate (G), cam (D) rotates. When the pawl leaves the angle-plate, the cam stops.

from the face of the cam are four pins *F*, equally spaced around the center of rotation. Angle-plate *G* is machined to a true arc of a circle on its upper edge, and is attached to a stationary part of the machine.

The shaft, arm, and pawl rotate as a unit. No motion is transmitted to the cam until the pawl contacts the upper edge of the angle plate, when the pawl is brought into position to engage one of the pins. The drawing shows the position of the components at about the midpoint of the cam movement.

Having engaged one of the pins, the pawl carries the cam with it, until it no longer contacts the angle-plate. At this point, due to the angularity of the contact surface of the pawl, it disengages automatically, and the cam stops. (The position of the pawl at the time of disengagement is shown in broken lines on the left side of the drawing.) Stop *H* limits the swing of the pawl so that it will be in position to engage the next pin upon rotating to the right side of the angle-plate. Thus, the cam rotates 90 degrees for each revolution of the shaft, and the four lobes of the cam are brought consecutively into position to actuate cam follower *J* as required.

Steplessly Variable Stroke Movement

H. H. Fronicke

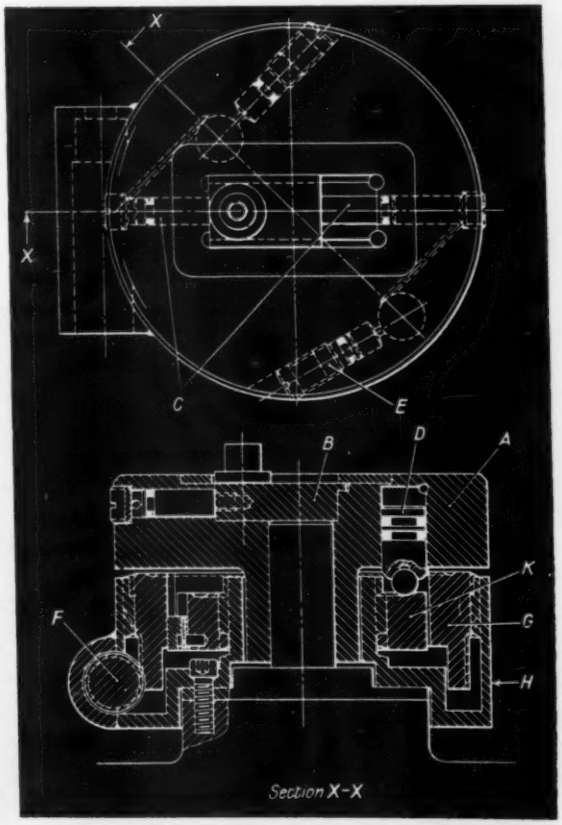
An arrangement employed on an optical profile-grinding machine that enables the length of stroke of a horizontal reciprocating slide to be steplessly varied is here illustrated. Of compact design, the unit has provision for bolting directly to a speed reducer.

Body *A* is keyed to the shaft of the reducer and houses a slide *B*. This slide incorporates a crankpin and is retained by a cover plate (not shown in the elevation). From the pin, motion is transmitted to the machine slide by a connecting-rod fitted with an Oilite bushing.

Two pistons *C*, forming part of a closed hydraulic system, determine the position of the slide *B* and, consequently, the throw of the crankpin and the stroke of the machine slide. The pistons *C* are controlled by pistons *D*, the cylinder bores being connected by transverse ports as seen in the elevation. To facilitate charging and setting, a piston *E* with screw adjustment is provided for each branch of the hydraulic circuit.

Adjustment of the stroke can be effected while the machine is running by turning a handwheel connected to the worm *F*. This member meshes with a worm-wheel *G* which in turn is threaded into a stationary housing *H*, permitting the worm-wheel to move into or out of the housing when the worm is rotated. A left-hand stub Acme thread is used for this purpose. From the worm-wheel, drive is also transmitted through a sliding phosphor-bronze key to the inner ring *K*, which has a right-hand thread. In consequence, this ring is always moved in the housing in the opposite direction to the worm-wheel axially.

Movement is transmitted from the worm-wheel or the inner ring to one of the pistons *D*, depending on the direction of the stroke adjustment, through a ball which runs in a track on the end face of the appropriate member (*K* or *G*). As one piston is raised, the other is permitted to move downward by reason of the right- and left-hand thread arrangement, and a corresponding motion is imparted to the pistons *C* and slide *B* which carries the crankpin.



Device for steplessly varying stroke of a reciprocating drive. Stroke can be changed while drive is in motion.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Lead-Screw Adapted for Gaging Long Shafts

ERNEST JONES, New York City

A handy arrangement for accurately locating shoulders and grooves in long shafts being turned in a lathe is illustrated in Fig. 1. The device, which consists simply of an attachment for counting the number of complete and partial turns made by the lathe lead-screw, is used to gage the carriage travel. This method eliminates the need for the long, specially made gaging rods.

A dial *A* is attached by a thumbscrew to the tailstock end of the lathe lead-screw *B*. This dial is calibrated in length of carriage travel, the number of divisions being equal to the pitch of the lead-screw in thousandths of an inch. The dial shown has 250 divisions. If its calibration is satisfactory, a milling machine dial can be used for this purpose. The end of the lathe bed *C* is drilled for a pointer *D* to permit easy reading of the dial. Resetting this dial to zero is a simple matter since it is secured with a thumbscrew.

Although dial *A* and a scale are all that are necessary to measure carriage travel to the 0.001 inch, a second dial *E*, calibrated in inches, may be added for convenience. Actually, dial *E* is a narrow-face gear of a suitable pitch to mesh with the lead-screw. This gear is mounted on a shoulder screw *F* secured in a block *G* (Fig. 2), which, in turn, is attached to the lathe bed. Screw *F* is oriented at a slight angle to the axis of the lead-screw to permit dial *E* to mate properly with the lead-screw. In addition, a pointer *H* is secured to screw *F* by a set-screw. To reset dial *E*, it is pushed in, depressing a spring *J* (Fig. 2) mounted behind the dial on screw *F*, and rotated to zero. Some lead-screws have keyways and are used for feeding as well as threading. In such cases, the portion of the keyslot that would interfere with dial *E* may be filled with solder and the solder filed in the shape of the threads. On most lathes, the key never reaches this end-portion of the lead-screw.

When turning long shafts, the regular feed-screw and a scale can be used to measure the

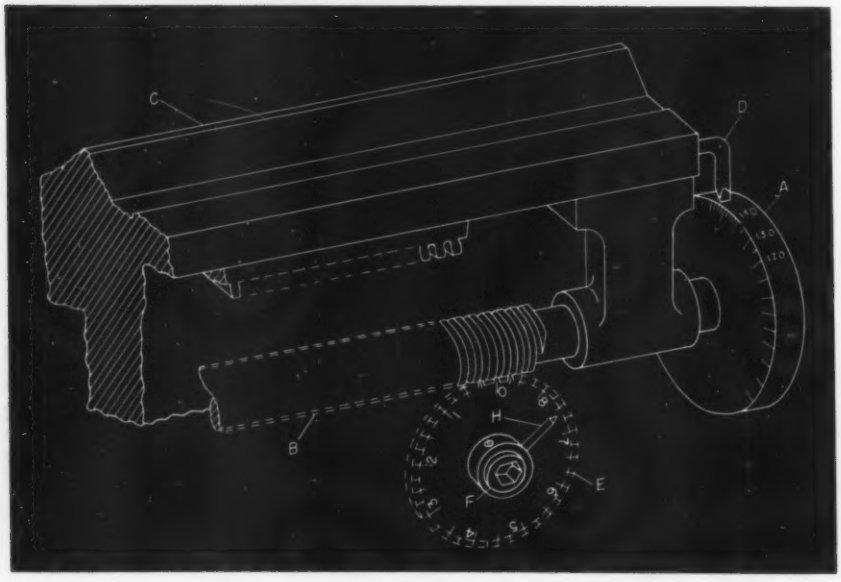
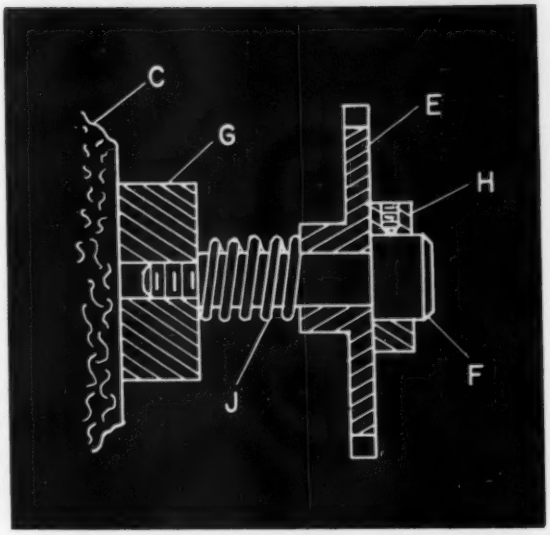


Fig. 1. Dials operated by lathe lead-screw that accurately measure carriage travel and are handy for turning long shafts.

Fig. 2. Method used for attaching dial (E) to the lathe bed (C) shown in detail. Spring (J) allows easy resetting of the dial.



roughing cut. Then, by changing over to the lead-screw for the carriage drive, the length of the finishing cut can be measured with dials *A* and *E*. A feed sufficiently fine for most finishing can be obtained by shifting the change-gears to cut the maximum number of threads per inch available on the lathe. If this is not satisfactory, dials *A* and *E* can be used in cutting the shoulders to length and the peripheral surfaces can then be finished with the usual fine feed. This attachment should not be used when the feed-screw is employed since the clutch may slip, destroying the accuracy of measurement. When the dials are in the position shown, the carriage has traveled 7.397 inches.

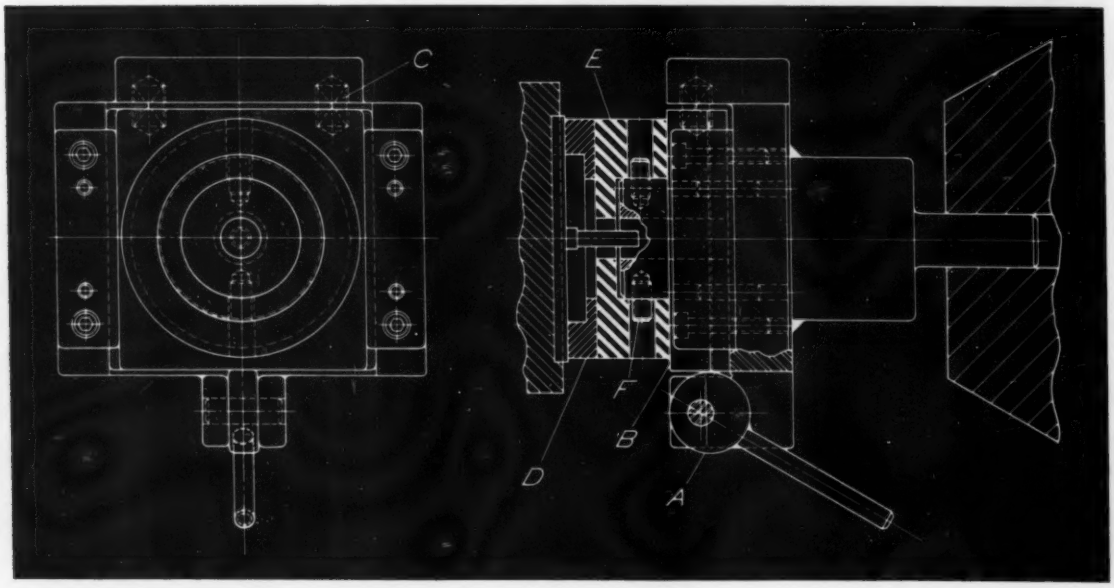
Surface with Protrusion Lapped on Hand Screw Machine

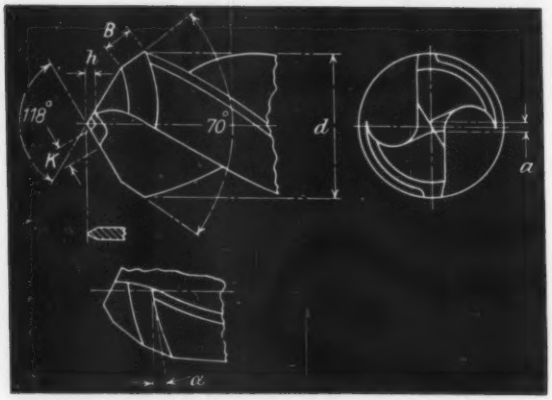
INMON V. HALE, Piqua, Ohio

Lapping the end of a small cylinder posed a problem because of the presence of a protruding shaft in the center of the surface to be lapped. To do the job, the work was chucked in a small hand screw machine, and the device illustrated was set up in one of the stations of the hexagon turret. The view is cross sectional, looking down from above the setup.

Cam *A* is actuated by the operator to advance slide *B* against the pressure of springs *C*, which retract the slide when the cam is reversed. Cast-iron lap *D* is bonded to rubber disc *E*, which in turn is retained loosely by set-screws *F*. In use, the tool is brought up to the work with light pressure, and the cam is rotated back and forth until the proper finish is obtained.

The floating action of rubber disc (E) permits the end of the work to be lapped despite the presence of a protrusion.





Drill point having a double angle and notched web is claimed to give longer life, and require less feeding pressure and power consumption.

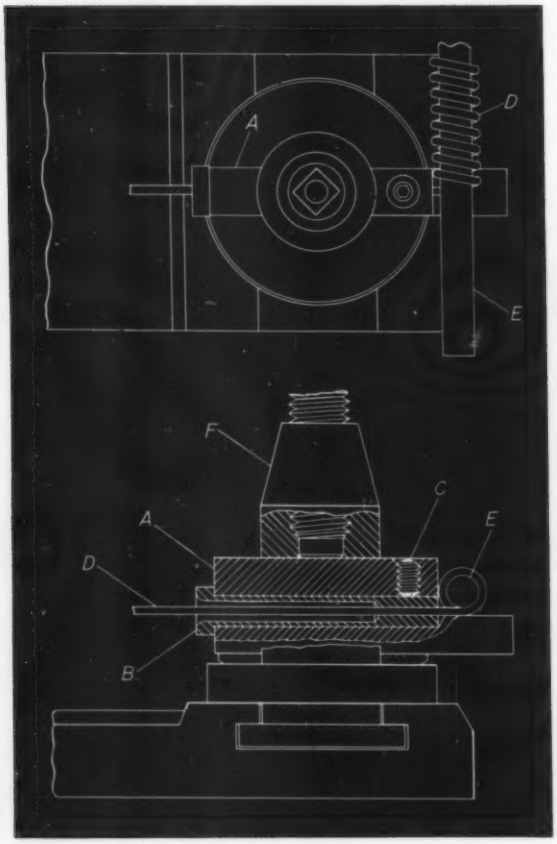
Dimensions of Various-Size Drills Having Double Angles and Notched Webs

d, Inches	h ±0.014"	a ±0.020"	K +0.020" −0.000"	B +0.020" −0.000"	α Degrees on Periphery
5/16 to 15/32	0.024	0.039	0.059	....	11 to 14
15/32 to 19/32	0.039	0.063	0.079	0.102	11 to 14
19/32 to 25/32	0.047	0.075	0.118	0.138	9 to 12
25/32 to 1	0.063	0.102	0.138	0.177	9 to 12
1 to 1 3/16	0.079	0.126	0.177	0.217	9 to 12
1 3/16 to 1 3/8	0.094	0.158	0.236	0.276	8 to 11
1 3/8 to 1 9/16	0.110	0.177	0.236	0.276	8 to 11

Longer Life Claimed for Double-Angle Drill Point

Drills having a double-angle point and notched web, as seen in the accompanying drawing, are being used in Russia with good results. It is claimed that two to three times the life is obtained (compared to conventional drill points) when drilling steel, and four to six times when drilling cast iron. Also, it is contended that the feeding pressure required is only a fraction of that needed for ordinary drills, and power consumption and heat generated are said to be appreciably lower.

For good results, it is essential that the drill-point form be produced to a high degree of accuracy, with symmetrical location of the notch being very important. Dimensions for various-size drills are given in the table.



Handy Arrangement for Lathe Winding of Coil Springs

ANDREW MIHALKO, Jackson, Mich.

A toolpost attachment for the lathe winding of coil springs from various sizes of wire is here illustrated. With this device, the required size and pitch of coil springs can be obtained with a relatively high degree of accuracy.

Holder *A* is made of steel and is drilled to receive a split bushing *B*. Pressure-screw *C* clamps the split bushing on the spring wire *D* as it passes through the bushing and coils around the mandrel *E*. Depending on the application, split bushing *B* can be made of casehardened machine steel or brass. One bushing can be used for several different sizes of wire. The lower side of the hole in any size bushing should line up with the horizontal face of the holder in contact with the wire.

In operation, the toolpost *F* is adjusted so that the wire is held in continuous contact with the holder at the two points shown. In this manner, equal tension is maintained on the spring wire during the winding operation. Pressure-screw *C* is tightened to apply the proper feed tension.

Convenient toolpost attachment that facilitates the lathe winding of coil springs.

Adventures in Progress . . .

Theme of Seventy-Fifth Anniversary at "the Mill"

DURING the month of October the Cincinnati Milling Machine Co. celebrated its seventy-fifth anniversary with a unique exhibition. About ninety up-to-the-minute machine tools were demonstrated to approximately 3000 special guests at the Cincinnati facilities as they toured the various divisions of the company.

In his keynote address Frederick V. Geier, chairman of the company's board of directors, declared that "our American way of life—indeed our very survival as a nation—depends in a large part on progress in machine tools." This phase of the celebration was held in a huge red and white striped Cimasphere—a plastic bubble-tent supported by interior air pressure. The Cimasphere is seen in the heading illustration.

Among the new equipment exhibited was an Intraform machine over 200 feet long employed to form precision tubing of both ferrous and non-ferrous materials. In addition to Intraform machines, the Meta-Dynamics Division also demonstrated the Hydroform and Hydrospin "chipless machining" processes. A Polaris missile-engine case head can be produced from a flat plate of 4340 steel into the dish-shaped part, 54 inches in diameter and having a finished wall thickness of 0.150 inch plus or minus 0.007 inch. The part is made in three tracer-controlled Hydrospin operations.

The Meta-Dynamics Division also demonstrated the hardening of the bore of an SAE 1062 steel automotive part in a completely

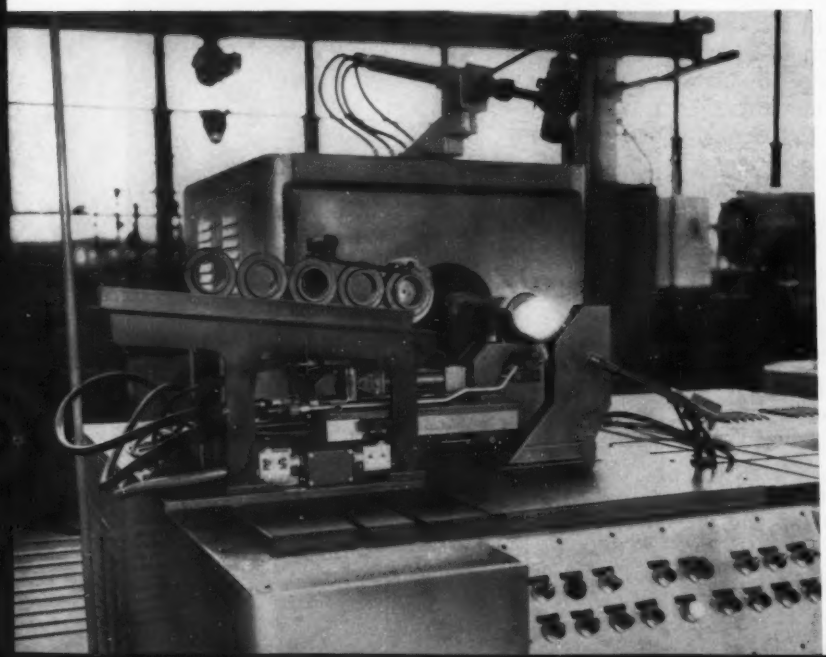


Fig. 1. Flame hardening the bore of an automotive part. This equipment is completely automated and has a rotating flame-head.

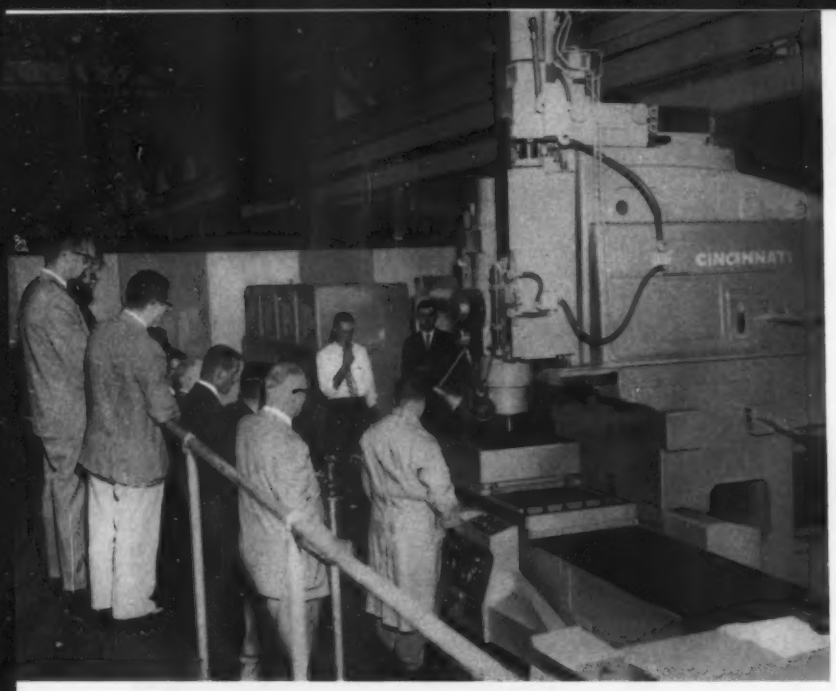


Fig. 2. (Left) Numerically controlled 30- by 52-inch vertical Hydrotel performing a die-sinking operation on a die for a milling-machine cover.

Fig. 3. (Below) This 24-inch sliding-head drilling machine is set up for automatic tapping of 1500 nuts per hour. A hopper feed and air-operated chuck are employed.

automated Flamatic heat-treating machine with a rotating flame-head (Fig. 1). The components were hardened at the rate of four per minute to 60-62 Rockwell C, the depth of hardness being 0.125 inch.

An outstanding feature of the anniversary program was the numerical-control center exhibit. There a 16- by 30-inch and a 30- by 52-inch vertical Hydrotel were shown in operation, the latter (Fig. 2) doing numerically controlled die-sinking. A numerically controlled 48- by 168-inch traveling-column Hydrotel contouring an aircraft part was also displayed.

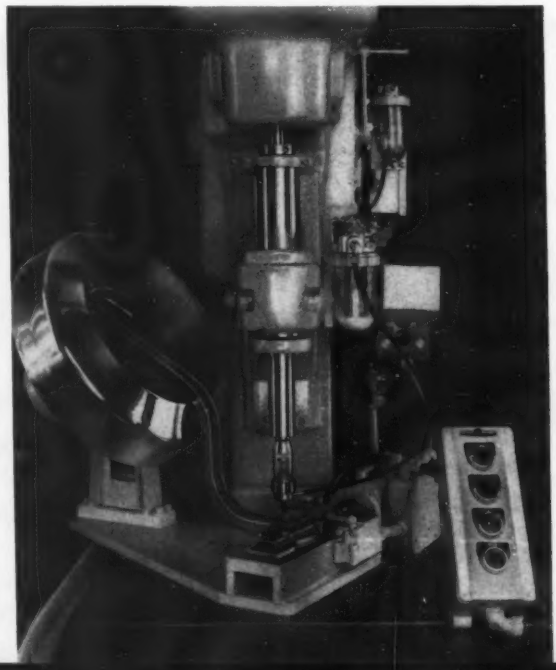
The Heald Machine Co. introduced a numerically controlled Bore-Matic precision contour boring and turning machine. This equipment can be used to generate contours within an area measuring 18 by 14 inches to a dimensional tolerance of plus or minus 0.0001 inch.

A numerically controlled lathe and a 24-inch sliding-head drilling machine equipped with a new economical 10- by 10-inch numerically controlled positioning table were exhibited by the Cincinnati Lathe and Tool Division. Also demonstrated was a 20- by 48-inch two-axis positioning machine having numerical control of position, speed, and feed. All seven of the numerically controlled machine tools shown were operated by Acramatic systems perfected by the company.

The Cincinnati Lathe and Tool Division introduced a new Hydrashift line of geared-head lathes which feature automatic hydraulic shifting arranged to allow spindle-speed selection by dial. This division also demonstrated its line of drilling machines which can be "customized" by the addition of standard accessories. A basic 24-inch sliding-head drilling machine that has been set up for the automatic production tapping of hexagon-nut blanks at the rate of 1500 per hour is seen in Fig. 3. The added equipment includes a hopper feed unit, an automatic clamping and ejecting air chuck, and an air feed tapping unit.

Other equipment announced includes a fixed-knee type general-purpose milling machine and an automatic cutter grinder which, once set up, will sharpen identical cutters without attention.

The Products Division exhibited a 256-foot kiln used in the manufacture of grinding wheels. Six days are required for the wheels to pass through the kiln, which reaches a temperature of 2300 degrees F. Demonstrations ranging in scope from web thinning by a Spiropoint drill sharpener to electrical discharge machining by the company's recently announced Elektrojet equipment were also featured at the anniversary program.



MACHINERY'S Reference Section

POSITION REGULATORS FOR MACHINE TOOLS

What you should know about them in order to design, sell, purchase, or use machine tools equipped with automatic control systems

JOHN L. DUTCHER
Metalworking Machinery Engineering
Apparatus Sales Division
General Electric Co.
Schenectady, N. Y.

November, 1959

Position Regulators for Machine Tools

AS MACHINE TOOLS equipped with tracer or numerical controls come into wider use, there is an ever-increasing need for engineers and others concerned with machine tools to understand the basic concepts of position regulators, or servos. This is true because the mechanical members of the machine tool are just as much a part of the regulator as are its electric and hydraulic components. The combined characteristics of the regulator and the machine tool determine, to a large degree, the final speed, accuracy, and ultimately, the productivity of the automatic equipment.

Regulator theory in its entirety is a very complex subject to which one can devote years of study and still have much to learn. However, most of us need not be experts. But we do have use for a knowledge of what a position regulator is, what makes it work (or not work), and the meaning of some of the more commonly used associated terminology.

This article attempts to present the basic concepts of position regulators in terms that can be understood by those who have had little or no previous contact with the subject. No differential equations, La Place transforms, or even quadratic equations are mentioned. It is believed that basic regulator theory is not as complex as some mathematicians might lead us to think and it is hoped that this article will help prove the point.

What a Position Regulator Is

As applied to machine tools, a position regulator is a group of mechanical and electric, hydraulic, or pneumatic components that controls the position of a machine slide through the use of some position-measuring, feedback device. Any difference between the actual position and the required position of the machine slide is sensed by the feedback device, and the regulator acts to minimize the error.

In a tracer system the regulator includes the tracer-head, electric and/or hydraulic amplifying and power elements, the gearing, lead-screws and bearings, and the support that connects the tracer-head to the machine slide. A position regulator is always a "closed loop." The closed loop is evident in Fig. 1. A tracer stylus deflection occurs when the slide should move. This deflection actuates the hydraulic cylinder and the resulting movement is communicated back to the stylus through the mechanical connection of the tracer-head to the slide. The tracer-head measures and corrects any error.

A regulator in a numerical-control system is similar. The template is replaced by electrical position information set up in the control by the program on tape. The position feedback is similar electrical information obtained from some position-measuring device such as a synchro, or pulse generator connected to the machine slide. The tracer-head is replaced by circuitry which senses any difference between the input and the feedback information—just as the tracer-head senses and corrects any error between the position of the machine slide and that of the template surface. The concept of feedback or error sensing in a closed loop is important because it is this self-monitoring, self-correcting characteristic of position regulators that permits them to perform with consistency and accuracy.

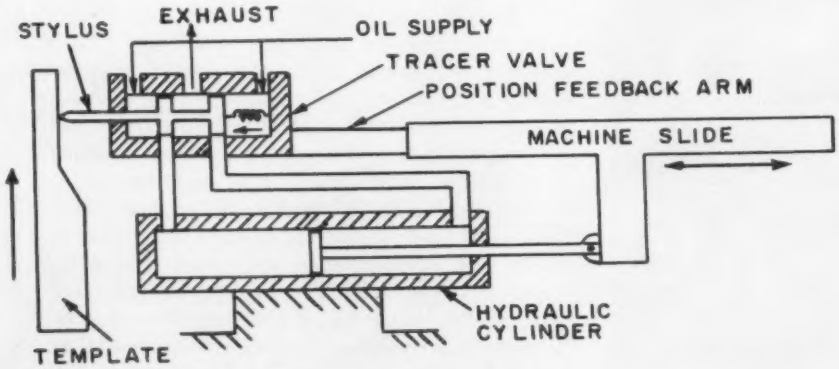


Fig. 1. This hydraulic type tracer system is a simple position regulator. Position feedback is provided by an arm connecting the machine slide to the body of the control valve.

Terminology

To be able to evaluate, apply, or effectively use various position regulators, one needs to know the meaning of some of the more common terms in the field and have an understanding of the significance of the characteristics which they represent. The terms given are first listed and briefly defined and then examples are used to more fully explain them. Words in parenthesis following each term are synonyms or other terms having essentially the same meaning.

Sensitivity (gain, "open-loop" gain)—A measure of the stiffness and accuracy of the regulator. It is the ratio of output (slide) speed to the position error required to produce that speed. The sensitivity also determines the minimum error required to overcome static friction and start the slide moving to make any position correction.

Velocity Error—Essentially the inverse of sensitivity. It is the amount of position error required to cause the machine to move at a given velocity.

Frequency Response (crossover frequency, band width)—This is a measure of the dynamic response of the regulator; its ability to suddenly change speed, follow a sharp corner, or stop without overshooting the desired position.

Feedback—Some means of comparing the actual position of the slide with the desired position for the purpose of minimizing any error between the two.

Instability (hunting)—The tendency of a poorly designed or poorly adjusted position regulator to continuously oscillate when it is supposed to be standing still or for its speed to vary in an unpredictable oscillatory manner when it should be constant or smoothly varying.

Radians per Second—A measure of frequency. One cycle per second equals 6.28 radians per second. (A circle equals 360 degrees, which in radian measure is 2π or 6.28 radians.) To easily (and approximately) convert radians/second to cycles/second simply divide by six.

How a Position Regulator Operates

The all-hydraulic tracer (Fig. 1) is one of the simplest and most easily understood position-regulator systems, so it will be used as an example. It should be kept in mind, however, that the characteristics described apply to all conventional types of position regulators.

The tracer-head is simply a housing containing a valve, the spool of which is moved back and forth as the stylus is deflected. At a null, or center point, the spool closes off the oil ports to both ends of the cylinder and the machine does not move. If the stylus and spool are deflected to the right from this null point, the machine slide moves to the right and its speed is proportional to the amount the stylus is deflected. (This is not a direct proportion in some tracers but that is of no consequence in this discussion.) The opposite motion of the slide results from deflecting the stylus to the left. This characteristic is plotted in Fig. 2.

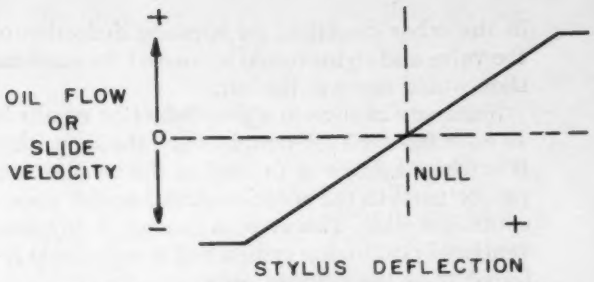


Fig. 2. Graph showing how the oil flow through the control valve (Fig. 1), and thus the velocity of the machine slide, varies with stylus deflection. Direction of stylus deflection from the null point determines the direction of slide travel.

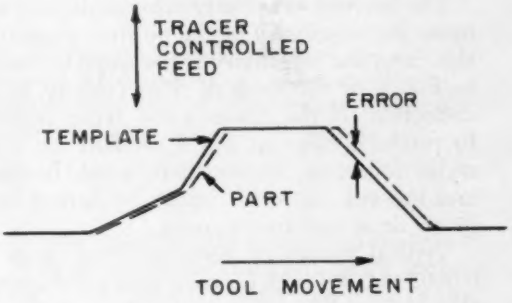


Fig. 3. A difference in shape proportional to the slide velocity occurs between the part and the template when a single-axis positioning system is used. This is known as the velocity error.

When oil pressure is applied to the system the slide and tracer-head move toward the template, the stylus contacts it and is deflected to the null point where the flow of oil to the cylinder is cut off, and motion stops.

As the template (Fig. 1) is moved upward, the tracer valve remains at the null point until the sloping part of the template is reached. At this point the valve is deflected to the right, porting oil to the cylinder, and causing the machine slide to move to the right. It is evident from Fig. 2 that the faster the template is moved or the greater its slope, the greater is the deflection required of the stylus to obtain the necessary oil flow and machine-slide speed. If the template were to slope

in the other direction, an opposite deflection of the valve and stylus would occur and the machine slide would move to the left.

Since any change in stylus deflection results in an error between the template and the shape that is machined, there is an error in the work that is proportional to the speed required of the tracer-controlled slide. This error is present in any conventional positioning system and is commonly referred to as the *velocity error.*

This means that the difference between the shape produced by the cutting tool and the shape of the template will be as shown in Fig. 3. If the cut had been made at a higher speed, all errors would have been increased proportionately.

The amount of velocity error is also dependent upon the *sensitivity* of the position regulator. In this case, the sensitivity is the slope of the curve in Fig. 2 or the ratio of slide velocity to stylus deflection. If the tracer valve were redesigned to produce twice as much oil flow for a given stylus deflection, the sensitivity would be doubled and the velocity error would be halved for any given slope and tracer speed.

Typical values of velocity error range from 0.0002 to 0.001 inch for each inch per minute that the tracer slide must move—for most tracers. Some numerical-control systems operate with higher sensitivities and thus have lower velocity errors.

Several different terms are commonly used for specifying sensitivity. One is the reverse of velocity error. That is, inches per minute (feed) per thousandths of an inch error. In these terms the systems having the velocity errors mentioned in the previous paragraph would have sensitivities of 1 to 5 inches/minute/0.001 inch error.

More technically, sensitivity is given in terms of inches per second per inch error. To convert sensitivities expressed in inches/minute/0.001 inch to units of inches per second per inch, simply multiply by 1000/60 or 16.7.

Equivalent sensitivities are:

1 inch/minute/0.001 inch (error) or
0.001 inch error for each inch per minute of controlled feed speed
16.7 inches/second/inch (error)
16.7/second gain

It would of course be fine to have all systems very sensitive but there are a number of reasons why there is a limit on the sensitivity that can be used. In the case of the hydraulic tracer being discussed, sensitivity is first determined by the design of the tracer valve. If sensitivity is to be increased, this valve must produce a greater flow of oil for a given stylus deflection. Obviously, there are limits in this regard. On the other hand, if the system makes use of electronic circuits, there is essentially no limit to the sensitivity that can be designed into the amplifier. But in any system there is a point beyond which a further increase in sensitivity will make the system un-

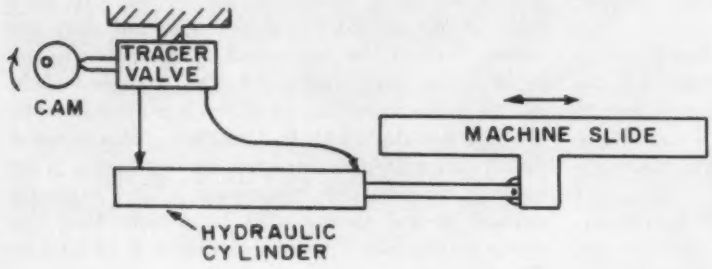


Fig. 4. (Left) Here, the hydraulic tracer system (Fig. 1) is shown with the feedback arm removed and the template replaced by a rotating eccentric cam. This open-loop setup and sinusoidal input are useful only for analysis.

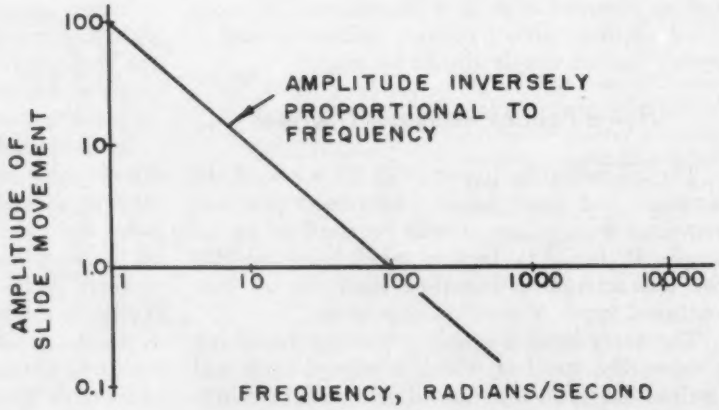


Fig. 5. (Right) In the system shown in Fig. 4, the amplitude of the slide movement is inversely proportional to the frequency of the sinusoidal input produced by the cam.

stable, causing the machine slide to oscillate, or hunt back and forth, in an uncontrolled manner.

The arrangement in Fig. 4 is the same as in Fig. 1 except that the body of the tracer-head is no longer connected to the machine slide. This amounts to removing the position feedback between the slide and the tracer-head. An open-loop system is the result. That is, the closed regulating loop has been opened by preventing the output motion of the slide from being fed back to the error-sensing element—the tracer valve. This is done here only for the purpose of analysis.

The simplest way to analyze these systems is to see what happens when they are supplied with a sinusoidal input of constant amplitude but varying frequency. For this purpose, a small eccentric cam has replaced the template. The cam is designed so that as it is rotated the tracer stylus is deflected in and out a small amount in a sine-wave motion. Various frequencies can be obtained by rotating the cam at different speeds. In the analysis which follows, the cam should be considered to move the stylus back and forth only a few thousandths of an inch from its null point so that the valve operates in the range where the oil flow is proportional to deflection (Fig. 2).

As the cam is rotated slowly, the stylus moves the valve spool so that first oil flows to one end of the cylinder. The valve then gradually closes and then opens to allow oil flow to the other end of the cylinder. As the valve spool is moved back and forth sinusoidally, a sinusoidal flow of oil is produced and a plot of the motion of the machine slide would also be a sine wave.

There are two things here that are important to recognize. First, if the cam is turned slowly producing a relatively low-frequency sinusoidal stylus movement, the valve will be open in each direction for a relatively long time. Since oil flows all the time the valve is open, the cylinder pushes the machine slide a relatively long distance during this time. If the cam is rotated twice as fast, the valve is only open half as long and the machine slide moves only half as far. Thus the amplitude of the machine motion is inversely proportional to the speed of cam rotation or input frequency. This relationship is plotted in Fig. 5.

The second important factor to note is that the motion of the slide lags the motion of the stylus by 90 degrees of phase shift (Fig. 6). The valve starts at its null point with zero oil flow. As it moves to the right the slide starts to move to the right. When the cam has opened the valve to its maximum position the slide is moving at maximum speed to the right. The cam starts to move the valve spool back toward the null or mid-position but until it gets there the oil flow is still

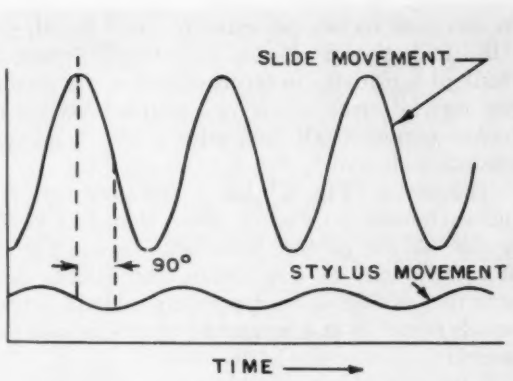


Fig. 6. Phase relationship between the sinusoidal movements of the stylus and the machine slide (Fig. 4). The output (slide) lags the input (stylus) by 90 degrees.

in the direction to move the machine slide to the right. Thus the machine does not reach its extreme travel till the spool has come back to the null point.

While the spool moves from the null point to the left, reverses, and comes back to the null position, the slide continuously moves to the left. The slide reverses at the point where the valve movement is in the middle of its travel. Thus, the two are 90 degrees out of phase, with the slide lagging behind the stylus. In other words, output lags the input by 90 degrees.

Actually what is desired in Fig. 5 is a plot of the ratio of output (slide position) over input (stylus displacement) versus frequency, and this is actually what has been done since the input amplitude is constant and can be considered to be unity.

This is a plot of the *open-loop transfer function* of this system: simply a plot of the ratio of output to input at various frequencies. Any normal basic position regulator has the same characteristic. The ratio of position output to position input (with no feedback) is inversely proportional to frequency and the output lags the input by 90 degrees. (Transfer function is a general term meaning the relationship of output/input versus frequency for any part or parts of the regulator.)

On these open-loop curves, the frequency at which the height of the curve is equal to one (where it crosses the unity amplitude ratio line and output equals error) is called the *crossover frequency*. This is an important and useful term which should be remembered.

There are some relationships shown in the curve of Fig. 5 that are very useful. First, it is

somewhat the habit to think of gain or sensitivity in terms of inches per minute (feed speed) per 0.001 inch of error. It may be better, however, to think of sensitivity in terms of inches per second per inch of error. There is a simple conversion: inches/minute/0.001 inch error $\times$ 16.7 = inches/second/inch error.

The servo (Fig. 5) has a sensitivity of 100 inches/second/inch error. Note that this (100) is the height of the open-loop curve, Fig. 5, at a frequency of one radian per second. Also note that the crossover frequency (where output equals error) is at a frequency of 100 radians per second.

If we had a system with a gain of 50 inches/second/inch error (50/16.7 or 3 inches/minute/0.001 inch error), the open-loop characteristic would be 50 at one radian per second and would be equal to 1.0 at 50 radians/second. The sensitivity, crossover frequency, and the height of the open-loop characteristic at one radian per second are numerically equal. (This relationship holds for basic systems of this type which do not have added stabilizing circuits to modify the open-loop characteristic at low frequencies. The relationship is, however, useful even in cases where these circuits are added.)

Closed-Loop Operation

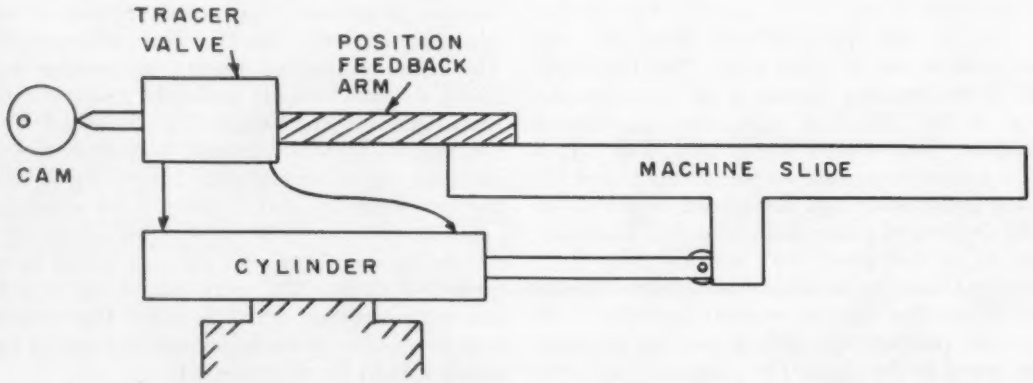
If the position feedback loop of the hydraulic tracer is reclosed by reconnecting the body of the tracer valve to the machine slide, a better look can be taken at the performance of the tracer. What was plotted in Fig. 5 was the ratio of slide position to *stylus deflection* at various frequencies with no connection between the slide and the tracer-head and this ratio was seen to vary inversely with frequency, for all frequencies.

Now, with the feedback added, Fig. 7, operation is changed. As the cam is turned slowly, opening the tracer valve, the slide is moved but this movement is fed back to the valve. Thus the slide moves back and forth essentially the same distance that the cam moves the stylus. Since the cam is turning very slowly, the velocities are very low and the velocity error (required change in stylus deflection to give motion) is extremely small. Thus, for all practical purposes, it can be said that the ratio of slide movement to stylus movement is unity, at low frequencies.

But, from Fig. 5, it can be seen that for successively higher frequencies a given sinusoidal opening of the valve produces less and less slide movement till at 10,000 radians per second the slide only moves one hundredth as far as the valve is opened. Thus, at the higher frequencies, essentially all stylus movement is error and the output (slide movement) is essentially zero. This relationship is shown by the open-loop characteristic in Fig. 8. The heavy solid line is a plot of slide motion/cam movement versus frequency, or closed-loop output/input, and is the *closed-loop transfer function* of the system.

The closed-loop transfer function shows that if the cam is rotated slowly the output (slide position) follows the input very accurately. As the speed of the cam is increased, a point is reached at which the output starts to become smaller than the input, and then at higher fre-

Fig. 7. Here, a position feedback arm has been added to the system shown in Fig. 4 to permit an analysis of closed-loop operation. The sinusoidal input cam has been retained.



quencies the output becomes inversely proportional to frequency.

Before continuing, it might be well to mention again that it is not being proposed here that these machines machine sine waves. The sinusoidal approach is simply the best method of analysis, and the results are a true measure of the performance of a position regulator when machining other shapes.

Frequency Response

Frequency response or *band width* are terms (generally having identical meanings) that are commonly used to measure the performance level of a position regulator or servo. The reasons why this is a good measure of performance will not be evident until after further discussion but the terms can be explained at this point.

The frequency response of a servo system, defined in the simplest terms, is the frequency at which the output starts to deviate appreciably from the input. It is the frequency at which the closed-loop characteristic (heavy line in Fig. 8) starts to drop appreciably below unity. In the case plotted in Fig. 8 this occurs at 100 radians per second. This is also the frequency at which the open-loop characteristic (output/error) equals 1.0, the crossover frequency.

In an actual position regulator, and using the strict definition of the terms, crossover frequency and frequency response are not exactly equal but they are so nearly so that they can be considered equal for the purposes of this article.

Instability

The simple system used in the example has a frequency response of 100 radians per second (approximately 16 cycles). Increasing the sensitivity (which raises the level of the open-loop curve) will increase the crossover frequency and thus increase the frequency response. However, it will be shown that there are a number of factors that limit how much the sensitivity can be increased.

None of the electric, hydraulic, or mechanical members that make up position regulators are absolutely stiff. The various mechanical members have mass and inertia and they and the hydraulic fluid compress when a load is applied. Electric components have inductance, capacitance, and resistance which result in time delays and losses between the input and output. A hydraulic cylinder, driving a machine slide, for example, behaves like a stiff spring driving a mass, since the oil is compressible like a spring.

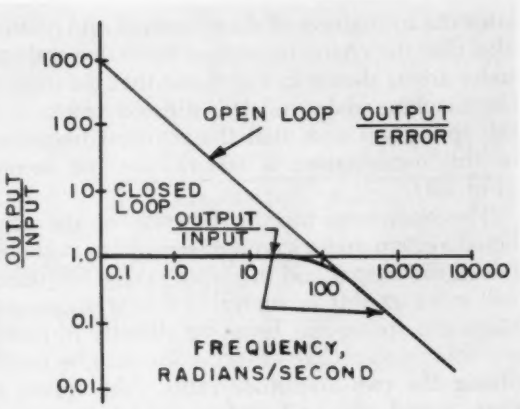


Fig. 8. Comparison of the transfer functions (output/input versus frequency) of the open-loop and closed-loop systems illustrated in Figs. 4 and 7, respectively.

A simple spring with the input end driven by a cam, similar to the one being discussed, and the output connected to a mass M which slides with a small amount of friction is illustrated in Fig. 9. The stiffness constant of the spring is K (pounds/inch).

A mass-spring combination like this has a resonant frequency (which is equal to $\sqrt{\frac{K}{M}}$ radians per second). That is, if the eccentric cam is rotated slowly, the mass will move back and forth essentially in correspondence with the cam movement. As the rotational speed of the cam (frequency) increases, a point will be reached where the amplitude of motion of the mass increases to a maximum (if friction is low). Then at frequencies above this resonant frequency the amplitude of movement of the mass decreases very rapidly, actually decreasing as the square of the increase in frequency.

In addition, as the frequency is increased, the motion of the mass tends to lag behind the movement of the cam until at the resonant frequency, the mass does not reach the end of its stroke to the right until the cam has moved fully to the right and returned to its mid-position. Thus, at the resonant frequency, the mass is lagging the cam input motion by 90 degrees. The two are 90 degrees out of phase. As the frequency is further increased the lag approaches 180 degrees. This characteristic is plotted in Fig. 10.

Consider again the hydraulic tracer with the feedback loop open as in Fig. 4, but with a stiff spring added between the piston and the mass of the machine slide (Fig. 11). (The spring simu-

lates the springiness of the column of oil.) Assume also that the characteristics of the valve and cylinder are as shown in Fig. 5 and that the mass of the machine slide and the stiffness constant of the spring are such that the resonant frequency of this combination is 100 radians per second (Fig. 10).

The open-loop transfer function of the combined system and a graph of the phase angle between the output and the input versus frequency will serve as aids in analyzing this arrangement. Since the spring has been put directly in series, the combined characteristic is obtained by multiplying the two amplitude ratios (the curves in Figs. 5 and 10) and adding the phase angles. (When two vector quantities are multiplied, their magnitudes are multiplied and their phase angles added.) The resulting relationships are shown by the solid-line curves in Fig. 12.

Addition of the spring has slightly changed the frequency at which the amplitude ratio is unity but more important, the phase shift in this frequency range has changed from the original 90 degrees to more than 180 degrees. Shifting the phase angle of a sine wave 180 degrees is the same as changing the sign of the function. So, in the area of the crossover frequency, 100 radians per second, the output of the combined system is essentially the negative of the input. The slide moves essentially the same distance as the stylus input but always in the opposite direction.

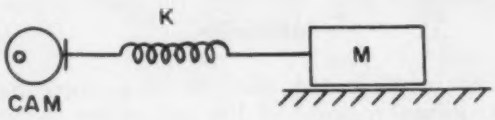
The performance of the position regulator (tracer) was, up to this point, based on the output (slide movement) being subtracted from the input (stylus movement) by the tracer valve through its feedback connection to the slide. But now, at frequencies around 100 radians per second, the output is negative so the two actually add at the valve. This means that the valve opening is now the sum (rather than the difference) of the stylus movement and the machine slide movement.

In effect, this sets up a vicious circle. The large valve opening results in greater slide movement and this in turn further increases the valve opening. The system will oscillate uncontrollably. The oscillation will occur at about 100 radians per second because at a higher frequency the slide movement is much less than the valve movement and at lower frequencies the phase shift is less than 180 degrees. This condition is known as *instability* or *hunting*. It is caused by the output lagging the input by 180 degrees, and a position regulator that exhibits such a characteristic is obviously useless.

Sensitivity and Stability

Increasing the sensitivity of the system would simply provide greater output for a given error and it would still oscillate or hunt. However, if the sensitivity were reduced, the system would

Fig. 9. (Right) Since oil is compressible, a hydraulic cylinder driving a machine slide will behave in a manner similar to a spring-mass combination.



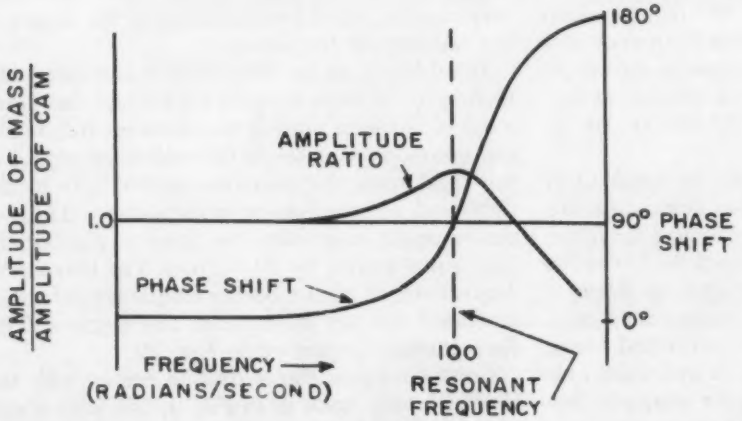


Fig. 10. (Left) Graph showing how the amplitude and phase shift of the spring-mass combination (Fig. 9) vary with the frequency of the sinusoidal input provided by the eccentric cam.

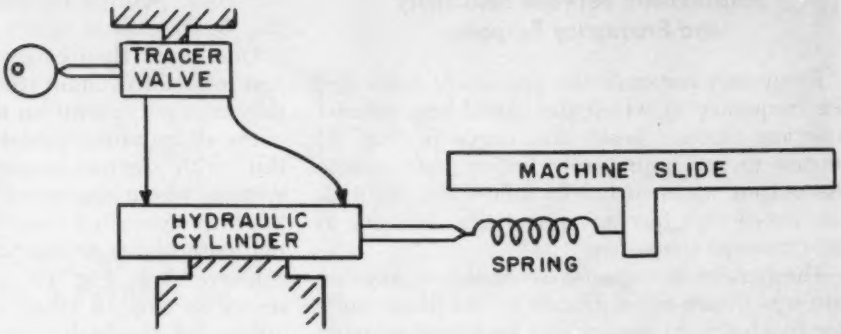


Fig. 11. Hydraulic tracer setup in an open-loop system (no feedback arm) but with a spring added between the piston and the machine slide. Eccentric cam, as before, operates stylus.

become stable. Reducing sensitivity reduces the amplitude ratio at all frequencies (lowers the broken-line and solid curves in Fig. 12, Graph A), but does not change the relationship of phase shift to frequency. Thus at 100 radians per second, where the phase shift is 180 degrees, the output is appreciably smaller than the error. Under these conditions, the system cannot sustain an oscillation and will settle down and be stable in operation.

This position regulator could be made stable in another way. If the mass of the slide were reduced or the spring made stiffer, their resonant frequency would be increased to a value higher than 100 radians per second. Assume it was increased to 500 radians per second—the total phase shift would then not become 180 degrees until the input frequency reached 500 radians per second. At this frequency the output is appreciably smaller than the error (amplitude ratio appreciably less than 1.0). The system, therefore, would not sustain an oscillation. In other words, at about 100 radians per second where the amplitude ratio became less than one, there was appreciably less than 180-degree phase shift so the system would not hunt.

This is the basic criterion of stability in any regulating system: at the frequency where the amplitude ratio, or output/error, is equal to one, the phase shift between error and output must be less than 180 degrees. To make a good, reliable system the phase shift should not be greater than 135 to 145 degrees.

Obviously a tracer system in which the hydraulic cylinder is connected to the machine slide through a spring would not exist. But the hydraulic cylinder itself behaves just like a spring because the oil is compressible and therefore the column of oil in the cylinder has a stiffness constant like that of a spring.

For example, assume that a cylinder of 3 1/2 inches effective diameter and 60 inches long operates a machine slide with a mass of 4000 pounds. This cylinder and mass will have a resonant frequency of about 100 radians per second, the same used for the spring in the above example. Thus, this position regulator would be unstable when operated at the sensitivity (100/second or 6 inches/minute/0.001 inch error) used in the example. The sensitivity would have to be reduced by a factor of two or three to one in order to assure a well-stabilized system.

Resonances can occur in these systems in many forms. Assume the power element is an electric or hydraulic motor which drives the machine slide through a lead-screw. The lead-screw has compliance in both torsion and compression and drives the mass of the machine slide. This mechanical component, therefore, has a resonant frequency and must be stiff if the phase shift that results from this resonance is to be negligible.

If the drive is by a rack and pinion, there will be a compliance in the pinion-shaft and its mounting which results in a resonance. There are many other mechanical resonances. If a rotary hydraulic motor is used, it is filled with compressible oil and drives into an inertia so it has a similar resonance. Electric circuits have the same characteristics. A filter circuit causes phase shifts. Or if the drive element is an electric generator and motor, the combination of the armature-circuit inductance and resistance and the inertia that is in the system will combine to produce a resonance.

These resonances limit the frequency response and seriously affect the usable sensitivity of any position regulator. For this reason, all components in the system, whether they be electric, hydraulic, or mechanical, must be made stiff so that the resultant resonances occur at acceptably high frequencies.

Relationship between Sensitivity and Frequency Response

Frequency response was previously defined as the frequency at which the closed-loop transfer function (lower, heavy-line curve in Fig. 8) started to fall appreciably below unity; where the output starts to fail to follow the input. It was noted that this was essentially the same as the crossover frequency.

The frequency response obtainable in any system was shown to be limited by the phase shifts due to whatever resonances occur in various parts of the system. Stated another way, the one or two lowest resonances in the system determine the maximum frequency response obtainable.

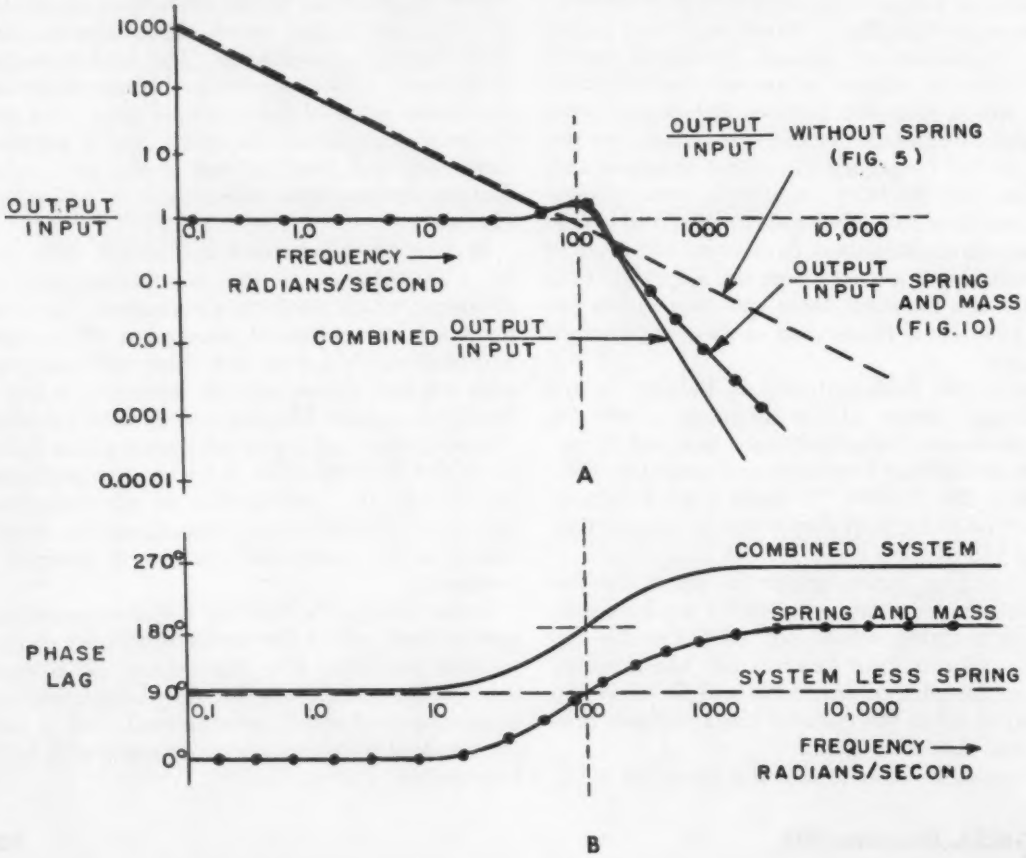
It was determined from Fig. 5 that a position regulator that had a crossover frequency (where output/error = 1) of 100 radians per second would have an open-loop output to error ratio of 100 at 1 radian per second and that this was equivalent to a sensitivity of 100/second. For any basic position regulator, such as the one in Fig. 5, these three values are numerically equal.

One could then conclude that since the system resonances limit the crossover frequency they also put a limit on sensitivity. This is true of the all-hydraulic system being discussed above. But, with electric systems or electrohydraulic systems where electronic amplifiers are used in the loop something can be done to allow operation with higher sensitivities.

Curve *A* in Fig. 13 is essentially the curve shown in Fig. 12 except that the resonant frequency of the hydraulic cylinder has been increased (by using a larger cylinder) to about 300 radians/second. This means that the system will be stable with the sensitivity of 100/second (6 inches/minute/0.001 inch error) shown.

Assume that a sensitivity of 1000/second (60 inches/minute/0.001 inch error) is required. This hypothetical system includes electronic circuitry and it is no problem to "design-in" ten times as much sensitivity or gain. The transfer

Fig. 12. Transfer function characteristics (A) of the open-loop tracer system (Fig. 4), the spring-mass combination (Fig. 9), and the combined system (Fig. 11). Phase relationships of these three systems are shown at (B).



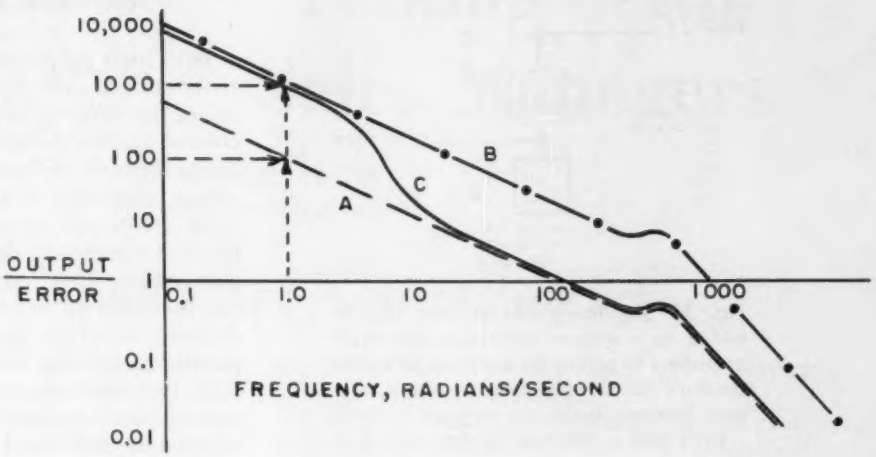


Fig. 13. Transfer functions of the open-loop combined system (Fig. 11) with the resonant frequency increased (curve A), with the sensitivity increased electronically (curve B) and, finally, with stabilizing circuits added (curve C).

function of this more sensitive system would be curve *B* shown in Fig. 13. But the output to error ratio is much greater than 1.0 in the 300 radian/second area of the curve at the cylinder resonance. The system will therefore be unstable.

But the sensitivity of the system is determined by the characteristic at low frequencies. (The height of the curve at 1 radian/second or the low-frequency part of the curve extended to this point.) Thus, this high sensitivity can be kept if a circuit can be introduced which does not affect the characteristic at low frequencies but reduces it at higher frequencies. One such circuit can be made up of resistors (R_1 and R_2) and a capacitor C as shown in Fig. 14.

At low frequencies, the capacitor behaves like an open circuit and the output and input are equal. At high frequencies the capacitor behaves like a short circuit and the output is smaller than the input by the ratio $\frac{R_2}{R_1 + R_2}$.

At intermediate frequencies the attenuation, or ratio of output/input, is somewhere between these values. Thus, by putting this circuit in series with the amplifier and selecting the right values for the capacitor and the resistors, the characteristic shown by the solid line (curve *C*) in Fig. 13 can be obtained. In this case, the high sensitivity has been maintained at low frequencies but the gain has been reduced to less than one at all frequencies close to the 300 radian/second resonance where this is necessary to attain stability. This is one type of stabilizing circuit.

The addition of stabilizing circuits allows systems to be operated at higher sensitivities than would otherwise be possible, but there are limits to the amount by which sensitivity should be increased in this manner. While the method allows an increase in sensitivity and thus a reduction in the velocity error, it results in overshoots on sharp corners, which is undesirable on machine tools.

Why Have High Frequency Response?

Frequency response has been defined as essentially the frequency at which the output ceases to follow the input accurately when the feedback loop is closed and the input is a sine wave or sine function. Of course, sine waves are not generally machined in work-pieces. The sine wave is used only as a means of analyzing.

The machining of shapes that have corners, requiring quick changes in the direction of a machine slide, however, is attempted. Frequency response is a measure of the ability to quickly change speed or direction. In effect, it is a measure of the ability of the regulator to follow small radii or sharp corners without excessive overshoot. Knowing the frequency response and sensitivity of a regulator, one can calculate what actual overshoots will be.

High frequency response in a position regulator also permits high sensitivity without the need for much or any stabilizing circuitry. Since holding this circuitry to a minimum is preferable, and high sensitivity is desirable and often necessary, this is a second advantage.

Why High Sensitivity?

A position regulator has been shown to have a velocity error—a position error that is proportional to the velocity of the output. In one-dimension tracers, this velocity error is directly manifest as an error in the work (Fig. 3), so it is

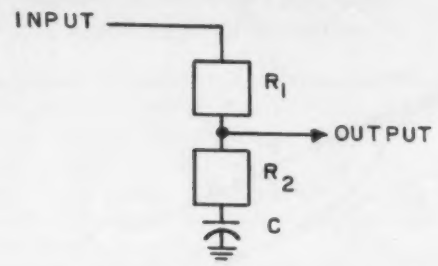


Fig. 14. Stabilizing circuit that can be added to a system containing electronic amplifiers to permit its operation at higher sensitivities. Overshooting at sharp corners, however, limits the increase in sensitivity that is practical by this method.

obviously desirable to have high sensitivity, and thus a low velocity error.

For two-dimension, 360-degree tracers or two (or more) axis numerical contouring systems the velocity error does not show up as a direct error in the work if the sensitivities of the regulators for each of the machine axes are equal. In numerical positioning (point-to-point) systems, velocity error as such is unimportant because they involve only static positioning.

In two-dimension tracer and all numerical-control systems, low velocity errors do relatively little to increase the accuracy of the part produced. But there are small errors in these systems caused by such things as drift in the amplifiers or hysteresis in hydraulic valves. Increased sensitivity reduces the errors that result in work-pieces due to these causes.

In all position control systems, high sensitivity is very important under static or low speed conditions. The *resolution ability* of a positioning control (the ability to correct for very small errors) is dependent on sensitivity. If the sensitivity of the system is high, only a smaller position error is necessary to overcome static friction and start the slide moving to correct the error. For the same reason, repetitive positioning accuracy is dependent on sensitivity.

Also, the circuitry of many automatic control systems is such that a certain minimum sensitivity in the position regulator is required. For example, if a tracer-head is designed to operate well only over a range of plus or minus 0.010 inch deflection and the top feed speed is 50 inches per minute, the sensitivity must be greater than 50/10 or 5 inches per minute per 0.001 inch error. Otherwise the stylus would have greater than the designed maximum deflection at top speed.

Factors Determining Performance

Both high frequency response and high sensitivity are certainly desirable. In any specific case, either the work to be machined or the automatic control system design determines the minimum limits for both of these factors.

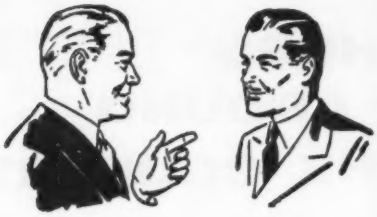
Since sensitivity is at least partially dependent upon frequency response, the latter is of the greatest concern in designing a position regulating system. The frequency response obtainable has been shown to be dependent upon the frequencies at which the various resonances in the position-regulating loop occur.

If the mechanical drive components—leadscrews, bearings, shafts, gearing, etc.—are made adequately stiff (and it pays to do so in most cases), the limiting resonances generally occur in the electric or hydraulic power components. These resonances are such that in the majority of cases the maximum frequency response obtainable that is practical will be in the range between about 20 and 120 radians per second or about 3 to 20 cycles per second. Where in this range the maximum frequency response of a specific application happens to occur depends largely on the type of drive used and the size of the machine.

It has been shown that all of the system resonances, including those of the mechanical machine members, must occur at frequencies well above the crossover frequency. This is why new automatically controlled machines are being made with what appear to be oversize leadscrews, extra thrust bearings and, in general, greater stiffness than has ever before been built into machine tools.

A pretty good job can now be done of designing a machine tool and the other components of a machine tool position regulator with assurance that the result will meet performance specifications, provided they are within reason. Regulator analysis is an exact, well-proven science, and results depend only upon the accuracy with which system constants and parameters can be predicted.

Care must be taken, however, not to overdesign. Normally, a minimum performance level is dictated either by the work to be done or by the characteristics of the over-all control system. Often these requirements plus a reasonable safety factor necessitate the highest performance possible in the position regulator. But at other times something less will produce adequate results and savings can be made. To obtain either of these results, the factors involved, their interrelation, and their effect on final performance must be understood.



Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

What Values Are You Selling?

THE MOST DIFFICULT ASPECT of machinery selling is that of making real to the prospect those values which lie beyond the machine itself. Picture the uselessness of your machine were it out on a desert island.

The purchase of any tool is the start of a triangular relationship, favorable or otherwise, between the supplier, user, and machine. The effect of this relationship cannot be overemphasized. Those values beyond the machine itself constitute the most important phase of sales engineering and one we most often neglect. The design and fabrication details of our particular machine are vital. But in selling we are very likely to let them crowd out ideas that affect the customer in his search for profits.

It is easy to talk about *things*, but much more difficult to create images and plant new ideas. Transition from *design* to *result* selling is the most pressing opportunity in selling technique today.

As one sales manager expressed the problem, "I have to get tough with our sales force every so often, to get them to quit talking so much about the construction and high quality of our machines. Selling time is terribly short these days. We must sell what the machine will do, and what we as a company will do to help make the machine do it. That's what triggers orders today."

The merchandiser of consumer specialties, such as cigarettes and breakfast foods, sketches images with emotional appeal that portray customers rewarded and happy. Machinery selling can be made far more effective if we devote more attention to creating images of what the machine will do to increase profitable production. Much progress has been made in this direction, but we still dilute our selling and confuse prospects by exploiting technical theory and data, rather than by giving proof of possible savings in simple and direct form.

What are these values we must make real?

For consumer goods, the merchandiser classifies them as availability, selection, quality, and guarantee. The value of each of these services disappears upon consumption.

With a machine tool, especially as the cycle of operation expands, its values or specialized services must directly affect the economic success of the user. What the machine will do must be expressed in dollars and other related satisfactions. The complexities that mark its performance may be very pertinent, but only as contributing to its efficient and continuing operation. We need to streamline selling to feature machine results. Construction detailing counts only if it shows what the machine will do to produce values for the shareholder, employe, and ultimate user.

What can the sales manager do to replace machine-*description* selling by machine-*profit* selling?

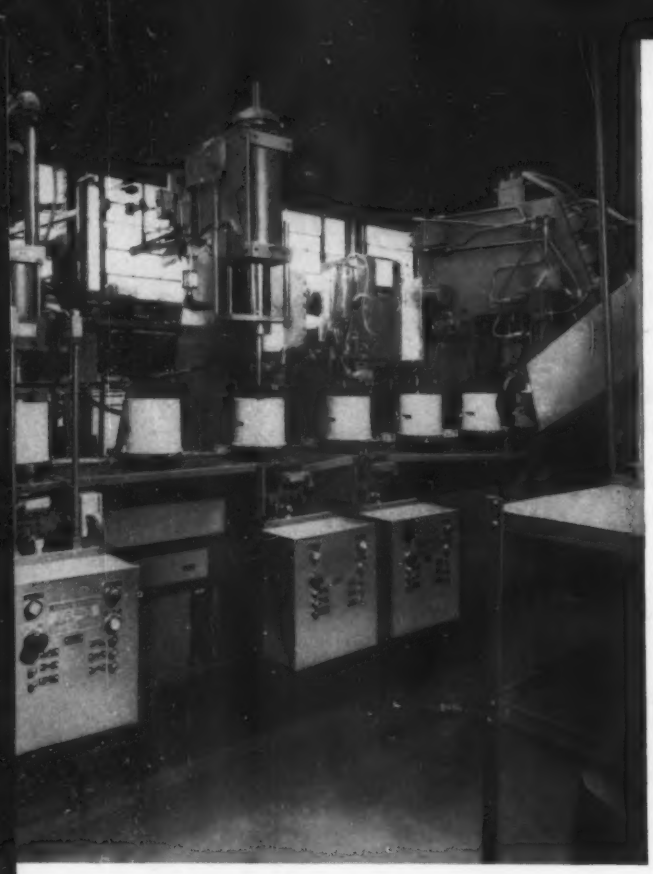
First—Show each sales engineer how vitally important it is to approach a customer's problem from his own viewpoint and environment, rather than from ours as a supplier.

Second—Dramatize the fact that any machine is only half-sold when its construction and operation are described. The other half of the problem is to get the prospect to visualize profit-making possibility in terms of dollars and human values.

Third—Stimulate inventiveness in selling. The clever designer invents machine traits that are new. The clever sales engineer finds new ways in which his machine can save and make customer dollars. Since people, not companies, buy and operate machines, "result selling" must be made personal. As one sales engineer answered when asked what machine he sold, "I don't sell machines. I sell profit-making installations."

Fourth—Complete your selling kit. Too many sales engineers, like some repairmen, don't carry a full set of the latest tools. We can improve our stock of selling tools by adding ideas.

The successful machinery builder today is not only reassessing familiar selling values, but introducing new ones, because these new ones show profits obtainable through use.

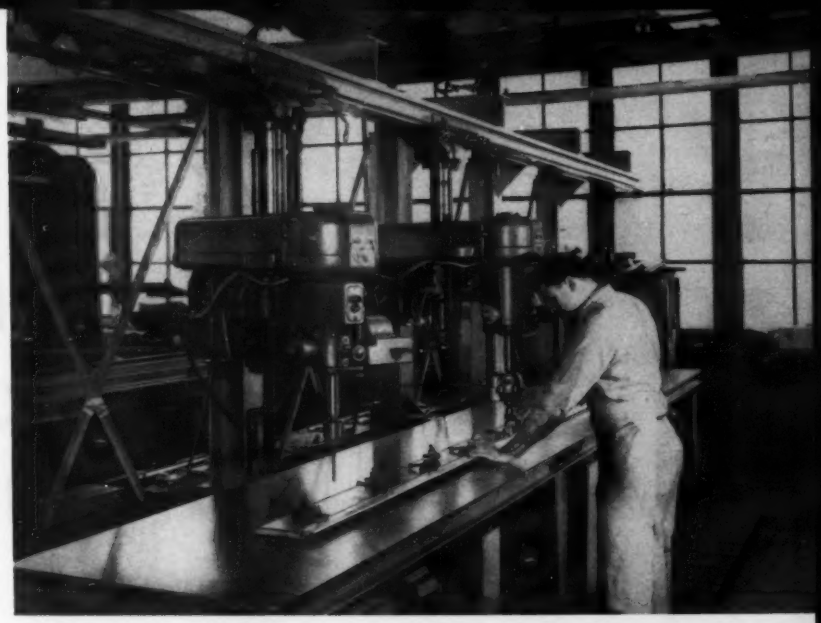


IN SHOPS AROUND THE COUNTRY

Camera highlights of some interesting operations performed in various metalworking plants

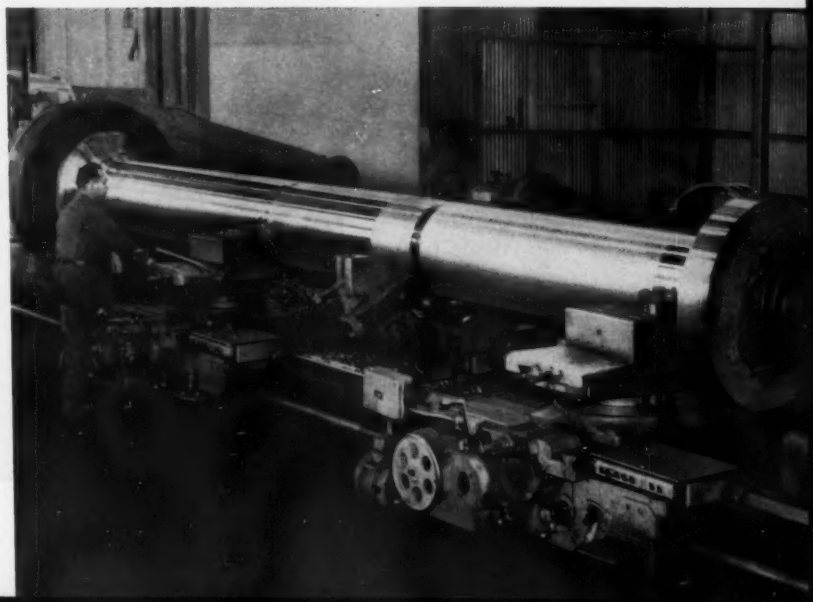
HOLE CONDITIONER—Unattended, six-station automatic line at Appliance Park, near Louisville, Ky., assembles and conditions powder-metal bearings for General Electric Disposall garbage-grinding units. Peening of the bearings by a Cogsdill "Bearingizing" tool produces a long-life 7-micro-inch finish to a tolerance of ±0.0006 inch.

RIVETING BULL—A bridge girder, fitted with its web and top and bottom chords, in a hydraulic riveting bull in the new girder shop of Bethlehem Fabricators, Inc., Bethlehem, Pa. Twenty to twenty-five rivets per minute can be driven. A five-electrode electric rivet heater is used with the bull. The bull and heater are carried through the building on their own jib crane.



TRAVELING DRILL PRESSES—At Kidde Textile Machinery Corporation, Bloomfield, N. J., two Walker-Turner overhead drill presses, mounted on a single crane rail, speed the drilling and tapping of guide bars for knitting machines. Each press is suspended from a ball-bearing carriage which is cranked along the rail. Kidde built the 18-foot-long table, with a cantilever support for the rail.

BUSY GRINDER—Bores of forty-seven different sewing-machine parts are ground on this Heald Gagematic, at the Chicago plant of Union Special Machinery Co. Here, a looper drive eccentric is being loaded into a hydraulic two-piece draw-bar fixture. Because of its odd shape, the part is centered by a loading shuttle which is then removed for the grinding.



SHAFT TURNER—A lathe operation on a propeller shaft 24 1/4 feet long and 23 1/4 inches in diameter, at National Supply Co., Torrance, Calif. Fourteen of these shafts are being produced for cargo vessels under construction for the American President Lines. The flanges on the ends, 40 3/4 inches in diameter and 5 inches thick, were upset-forged prior to machining.

PRODUCTION SHAPE-CUTTING BY CENTRALIZED CONTROL

FOUR MOTORIZED TORCHES designed for use with acetylene, propane, or natural gas and operated from a centralized control position are a feature of an 8-foot Linagraph shape-cutting machine of pantograph design recently demonstrated at Air Reduction's Equipment Manufacturing Plant in Union, N. J. This machine is capable of shape-cutting and straight-line-cutting anywhere within a rectangle bounded by a 96-inch width and any indefinite length determined by the number of rails and tracks used. For example, when two 10-foot lengths of rail and track are coupled together, the cutting area is 8 by 16 feet. The tracing area is provided with a movable table, measuring 8 by 4 feet, that carries the template.

All controls for gas pressure, the motorized torches, the machine carriage, and the tracing device are located directly above the mobile tracing table within reach of the operator. This centralized system simplifies the over-all operation. It also cuts down the floor space necessary for the installation of the machine since both the tracing equipment and the machine carriage

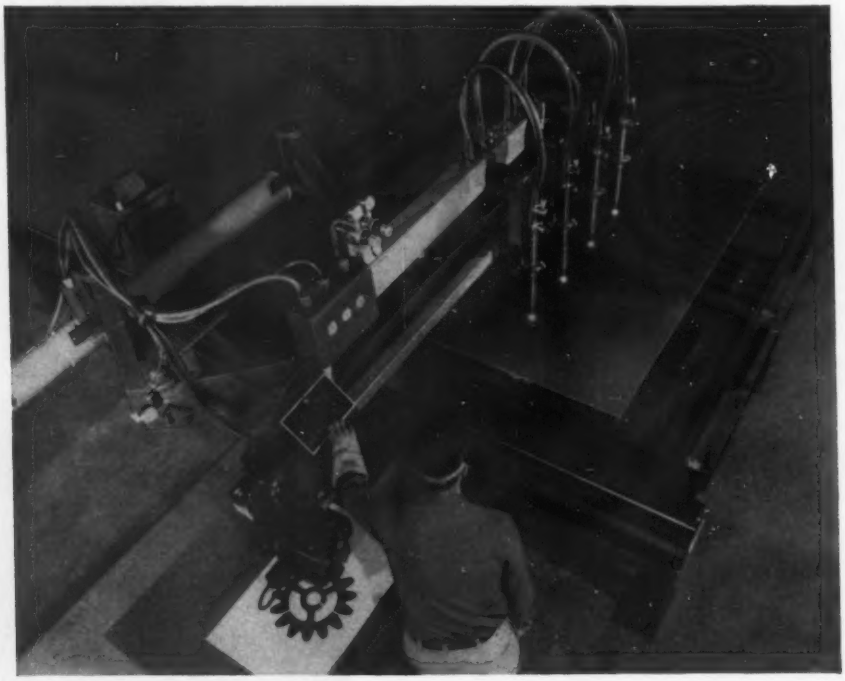


Fig. 1. A centralized control system minimizes floor space and assures convenient control of the new Airco Linagraph shape-cutting machine.

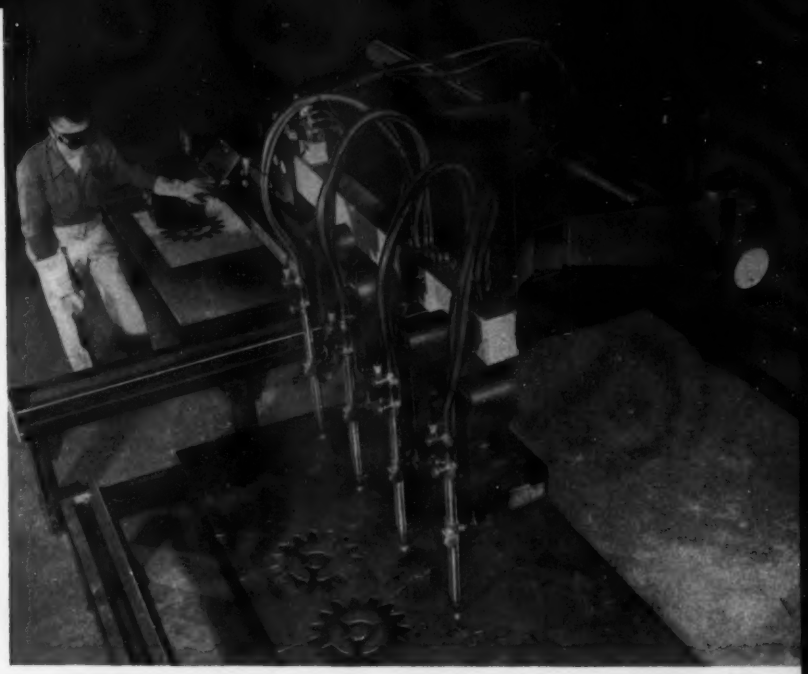


Fig. 2. Up to four torches that operate on acetylene, propane, or natural gas can be used for production shape-cutting on the Linagraph machine.

occupy the same space. The machine is designed for medium-duty cutting on 8-foot-wide steel plate. The illustrations show it engaged in cutting large sprockets.

Either left- or right-hand operations can be performed. The left-hand unit has its tracing area on the left-hand side and the cutting area on the right-hand side, when the machine is viewed from the front. Conversion from left- to right-hand operation and vice versa can be accomplished in the field. The machine can be equipped with manual, magnetic, or Aircotron (electronic) tracing units.

Movement of the pantograph arms is brought about by movement of the tracing device on one end of the torch bar. Friction between the driving wheel of the tracing device and the template transmits motion to the bar on which the torches are mounted. Motion of the pantograph-arm carriage is actuated by limit switches located on the arms. The carriage is mounted on tracks located on the outside raised rails. The tracks are 1 1/2-inch diameter solid steel bars. The rails also support the movable template table.

Movement of the carriage occurs when the pantograph arms reach the limits of their operating range. The proper forward or reverse motion of the carriage is dictated by the arms.

The carriage speed is set at 35 inches per minute. A flywheel on the motor which powers the carriage insures smooth starting and stopping. The motor can be readily disengaged from the carriage power wheel when it is desired to position the carriage manually anywhere along the rails. The carriage motor runs on 110-volt alternating current.

Welder Developed for Missile Program

A machine to weld thin gage materials for the U.S. Army missile program has been developed jointly by the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., and the Miller Electric Co., Appleton, Wis. Trailer-mounted and gasoline-engine driven, the machine is a shielded inert-gas arc welder that furnishes both alternating and direct current for metallic-arc or tungsten inert-gas welding. The unit also provides direct current for metal inert-gas welding and consumable electrode-process welding by the attachment of any commercially available wire feeders and consumable wire guns. These include push or pull and water- or air-cooled type guns up to 300 amperes.

Cutting Tools Made of Preformed Wafers

A new process in which cutting tools are produced of preformed metal wafers has been developed by Spiral Carbide Tool Co., Detroit, Mich. The method eliminates a number of machining operations in the manufacture of cutting tools and is applicable to many types, including carbide and high-speed steel types. The wafers are stamped with the basic configurations of cutting tools incorporated into their design. They are then assembled on arbors corresponding to standard sizes, lengths, and styles of tools already in use. Cutting tips are placed into appropriate cutouts and the entire assembly is brazed into a solid mass. The tips can be sharpened by conventional grinding methods.

TURRET PUNCH PRESS OPERATED BY TAPE

The combination of the world's first numerically controlled turret punch press and a new system for preparing tape is slashing hole-piercing costs

At General Electric's Specialty Control Department, Waynesboro, Va., a large turret punch press is automatically locating and piercing holes in panels at record speeds. Called the Wiedematic, the 100-ton press is the first application of numerical-positioning control to turret punching operations.

The press was built by the Wiedemann Machine Co., King of Prussia, Pa., and was designed specifically from the ground up for tape operation. G-E, working in conjunction with the builder, developed the numerical-positioning control, as well as a unique tape-preparation system.

All press functions—tool selection, material positioning, and piercing—are controlled automatically. Openings of any size or shape up to 8 inches in diameter are completed in as little as one-fifth the time required by a manually operated punch press of the same size. Switchgear panels, heater end plates, and similar parts up to 60 inches wide, 100 inches long, 3/8 inch thick are produced. A representative work-piece can be seen in the close-up view, Fig. 1.

Operation of the Wiedematic is reduced to push-button simplicity. All of the information required to complete a job is programmed on a standard eight-channel, 1-inch wide tape. The operator merely loads the material on the press table, inserts the tape in the reader, and starts the press. Simultaneously, the material is moved lengthwise and crosswise to the designated center-line dimension at a speed of 600 to 800 inches per minute, while the turrets rotate to bring the proper punch and die (at any one of thirty-six stations) into piercing position in less than two seconds. As soon as all three motions are completed, the press trips. During the piercing operation, the information for the next hole is read, and the table and turrets move immediately as required with no lost time. Since all hole locations are taken from a zero reference, there is no cumulative error.

The numerical-positioning control equipment, a closed-loop servo system, is self-checking. All operator controls, along with the tape reader, are enclosed in a console, as can be seen in the heading illustration.

The punch and die turrets, 55 inches in diameter, are indexed to approximate position by a hydraulic motor, after which they are locked positively by pins in the turret periphery. Table motions are powered by double-rod hydraulic cylinders.

Four work-holders (two appear in Fig. 1) grip the front edge of the sheet. Whenever a hole has to be pierced near the edge and in front of a holder, a signal generated by a proximity pick-up registers with a profile cam located in front of the

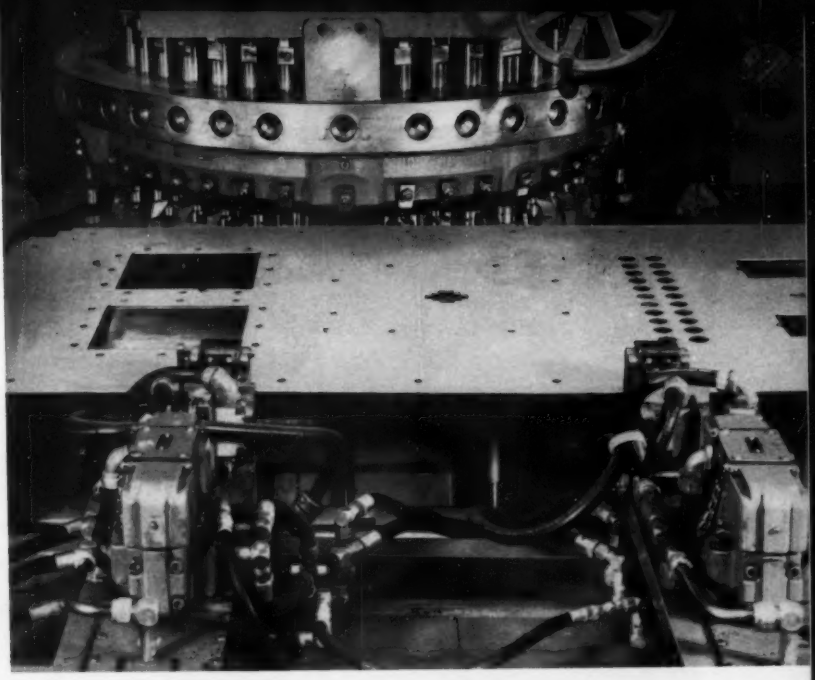


Fig. 1. (Right) The holders in the foreground grip the edge of the sheet, moving it from one piercing location to another.

Fig. 2. (Below) In operating the Auto-programmer, the draftsman uses half-scale dimensionless drawings to automatically produce the punched tape for the Wiedematic.

turrets, the jaws of the holder open, and the clamp is retracted. In this way, clearance is provided. Then, when the head moves away from the cam in the subsequent positioning of the work, the holder returns and the jaws close.

Tape preparation is accomplished easily with either a standard tape-punching machine, working to a simple work chart listing the X and Y dimensions and turret station number for each opening, or by a new Auto-programmer (Fig. 2) developed by G-E. This latter unit can produce a tape from a dimensionless line drawing using an optical system. With this method, drafting time can be reduced approximately 75 per cent, and the possibilities for human errors have been minimized.

A typical job for the Auto-programmer begins with a rough layout prepared by an engineering assistant using drafting templates. After templates have been roughly positioned on an outline drawing of the panel, a draftsman accurately positions the templates and secures the entire layout to the Auto-programmer. He then selects the required turret punch positions through selector switches on the machine's control console. A locating device is next centered, using lighted cross hairs over center-line markings on the templates for the punch desired.

A foot switch transfers X and Y dimensions, as measured by the locating device, from the layout to storage and read-outs. A second foot switch causes the information to be punched on tape. At the same time, the center-line location just programmed is automatically marked on the layout by a felt pen to eliminate possibility of repeating holes accidentally.

A diazo transparency is then made of the layout. After part numbers and a drawing number have been added to the transparency, it becomes an assembly drawing for use in the plant. At this point, a duplicate tape and a specification sheet are produced by a special automatic typewriter using the programmed tape, to provide a visual check for any possible engineering errors before production is started. After being inspected, the duplicate tape is inserted in the reader in the control console of the Wiedematic.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

"Speedking" Boring, Turning, and Facing Machine

A "Speedking" two-spindle, opposed-head machine now rounds out the line of precision automatic boring, turning, and facing equipment built by the Atlantic Instrument Corporation, a subsidiary of American Electronics, Inc., Norwood, Mass. The two other models consist of a "Unimatic" single-spindle unit and a "Boreking" twin-spindle unit (See MACHINERY, September, 1959, p. 212). In principle, a centrally located table carrying double tooling shuttles between the heads, each of which grips and rotates a work-piece. While one work-piece is being machined, the inoperative head can be unloaded and reloaded, so that production is virtually continuous.

An unusual feature of the machine is its bed—a heavy granite slab, ground and lapped to 0.00005-inch accuracy. Since granite is extremely stable, there is no deflection of the heads due to ambient temperature changes. Accuracy can be held to within close limits without the necessity of controlling room temperature. The bed is isolated from the cabinet below it by a molded rubber cushion.

Each head contains a Pope cartridge type ball-bearing spindle. Chucks and fixtures are readily adapted to the spindle nose, which is threaded. Standard collets fit the ground bore of the spindle. The rear of the spindle is ground to receive air-operated collet and chuck closure mechanisms. Inside the cabinet are individual U. S.

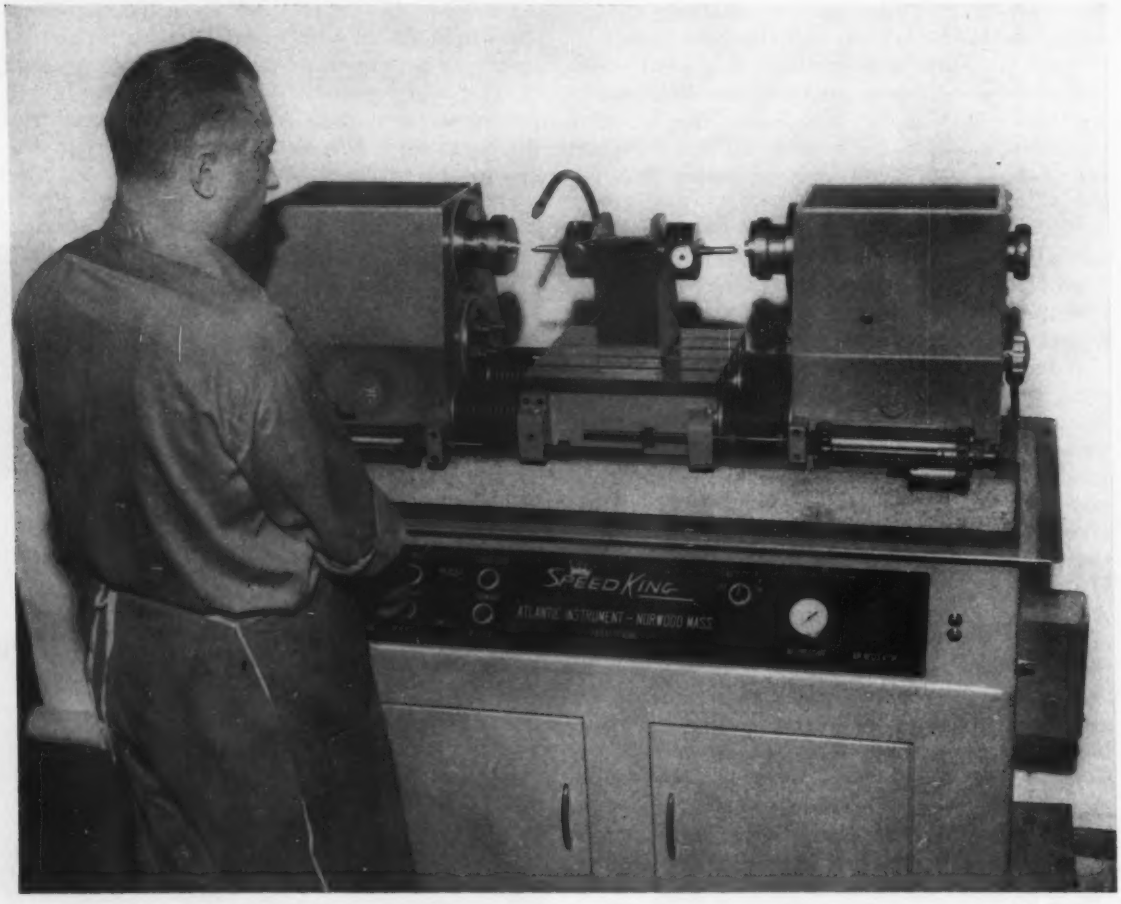


Fig. 1. "Speedking" automatic precision boring, turning, and facing machine

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

Varidrive motors for the two spindles. High-low push-buttons provide an infinitely variable speed range of 400 to 4000 rpm. A pair of solenoid-operated air brakes is actuated by the table movement.

Bearings for the table consist of two 2-inch round, hardened, and ground steel ways, protected by accordion-pleated boots. Rapid traverse, feed, and dwell of the table in both directions are controlled by Bellows air cylinders and Hydro-checks. Each head contains an adjustable four-station indexing turret stop by which the table can be accurately positioned on the ways for precision step turning or boring or facing.

The cabinet is a steel fabrication, with two front doors, a removable rear panel, tool-storage area, and control panel mounted at an angle. A coolant pump and reservoir are mounted in the cabinet top.

Circle Item 565 on postcard, page 191

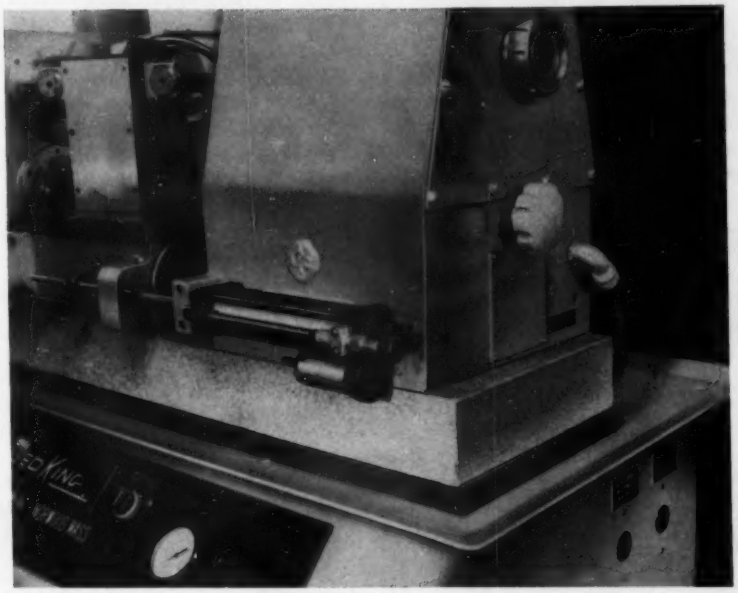
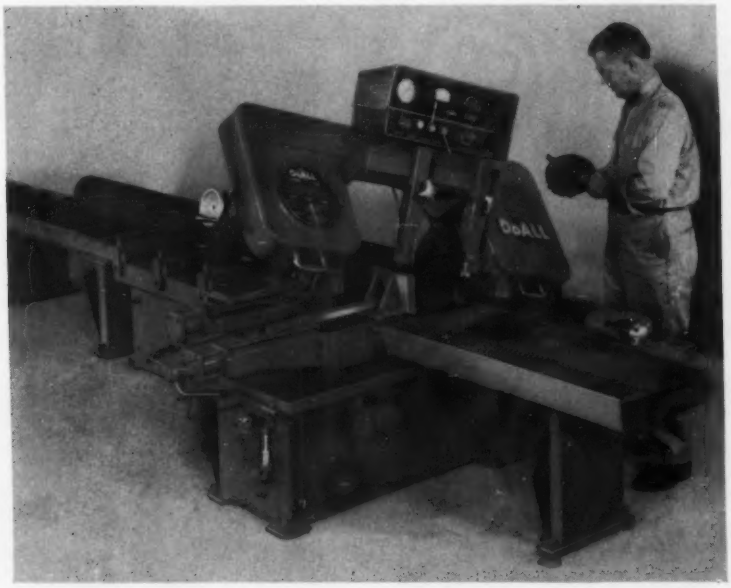


Fig. 2. Close-up view of one of the heads, showing granite bed and air feed system



Model C-68 DoALL power saw designed for fast, accurate, automatic cutting

DoALL Precision High-Speed Saws

Two cutoff machines designated Models C-67 and C-68 power saws have been announced by the DoALL Co., Des Plaines, Ill. Designed specifically to use DoALL's "Demon" high-speed steel saw bands, these machines are said to feature greater accuracy and higher production rates than the earlier models they replace. The Model C-68 is a 12- by 12-inch capacity machine equipped for fully automatic stock indexing. The Model C-67 is similar to Model C-68 except that the stock is manually fed and the capacity is 12 by 16 inches. Model C-68, shown in the accompanying illustration, will be described.

The controls and dials are grouped on a panel for the best sequence of operation from either

side of the machine. Large, easy-to-read instruments, nonslip control knobs, and no-glare panel serve to minimize operator errors. Mounted on the cutting head is a complete job selector. Over 200 materials are listed to facilitate quick selection of proper band size and pitch, band speed, and coolant mixture. This listing also shows anticipated cutting rates.

New features include spring-loaded saw guides that compensate for both band-gage differences and band wear. Replaceable wear plates in the bed of the machine take the wear and tear of heavy work-pieces. A new predirected coolant applicator carries coolant to both sides of the band to assure longer band life and good finish. Band feed pressure is infinitely adjustable throughout its wide range to facilitate accurate setting.

The control panel includes a work-height selector that eliminates unnecessary cutting-head travel. The operator simply sets this selector for the stock size to be cut in either rounds or rectangles. The device then automatically elevates the cutting head just enough to clear the stock between each cut. For setup, three-way saw positioning can be used to raise, lower, or lock the cutting head. The band speed indicator is an electrical tachometer that is accurate within 3 per cent of the true band speed. The new type feed-rate indicator is a 3 1/2-inch diameter suppressed type gage. This gives full-scale deflection, which simplifies accurate setting.

An automatic lock prevents any movement of the cutting head when the machine is turned off. A safety switch on the band tension cylinder also prevents operation in case the saw band is not at proper tension. If a saw band were to break, for example, the machine would stop and the cutting head would not drop.

Spring-loaded saw guides are automatically adjusted to the variations in band gage and to allow for wear. Constant pressure on the band is assured without manual adjustment. The carbide-faced backup bearings are supported by two heavy-duty ball bearings. The chip box located directly below the chip fall-off point prevents pile up without need for the operator's attention.

In addition to the new hardened replaceable wear plates, a filler plate is provided between the main vise and discharge table to support material as the cutoff is completed. This eliminates band pinching when cutting long pieces and jamming when cutting short pieces. The indexing mechanism of the Model C-68 can be set up quickly and is fully automatic in operation. It utilizes a hydraulic indexing vise to feed stock up to 12 inches in diameter or 12 inches square in any desired length increments up to 24 inches. Its capacity is 4000 pounds. The length of cut can be easily set to within 1/16 inch. While the guaranteed length accuracy is plus or minus 1/64 inch, it can be easily held to a few thousandths in production. For manual indexing of cutoff stock the discharge table has a 24-inch scale for approximate measurement with a micrometer work stop mounted so that it can be swung out of the way when not in use.

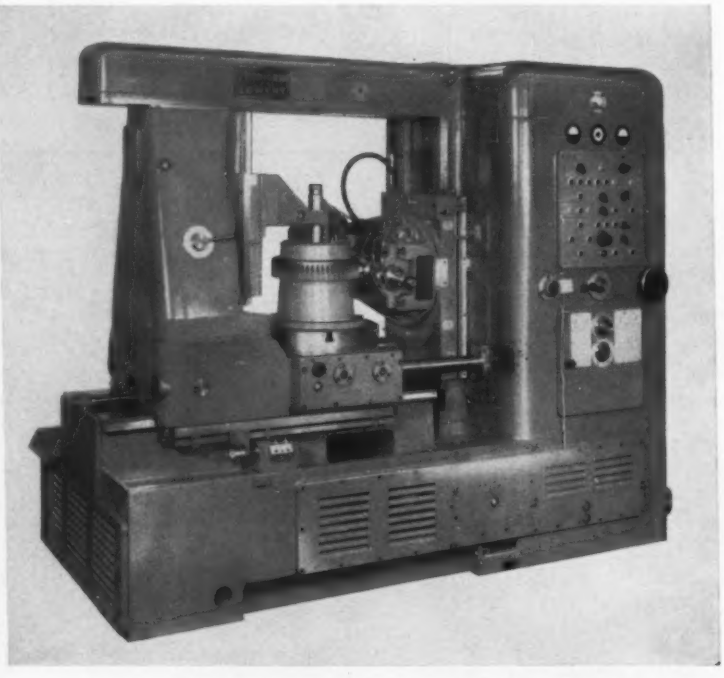
A 3-hp electric motor drives both the carrier wheels and hydraulic system. The drive mechanism and electric motor are fully protected from coolant and chips. The self-contained coolant system recirculates 5 gallons per minute of coolant over the cutting area from a 15-gallon reservoir.

Special attachments which widen the range of applications include a slow-approach selector, a pre-set counter which stops the machine after cutting any predetermined number of pieces up to 9999, and a multiple-index attachment. The latter attachment has three settings, 0 to 24 inches, 24 to 48 inches, and 48 to 72 inches. This unit is mounted on the feed table for cutting lengths longer than the usual 24-inch maximum-capacity setting.

Circle Item 566 on postcard, page 191

High-Speed Hobbing Machines Added to Michigan-Lorenz Line

Highly versatile, high-speed hobbing machines have been added to the Michigan-Lorenz line of hobbers and gear shapers introduced by Michigan Tool Co., Detroit, Mich. The U. S. modifications of



Michigan F-600 hobber for gears up to 24 inches in diameter

the German Lorenz "F" series hobbers, the line of four basic models, actually combines the high versatility needed for job-lot hobbing with the high-output capacity of mass-production type machines. As on other Michigan-Lorenz machines, modifications include the use of motor drives and controls made in this country. All settings and dials are also made to U. S. measurements.

The hob spindle speeds are infinitely variable from 20 to 400 rpm simply by turning a control knob. Axial and radial feeds are also infinitely variable. These automatic-cycling machines can be used for either single-cut or two-cut work. Step hobbing with automatic variation of feeds and speeds can also be accomplished within a work cycle. The latter feature is particularly important when the machine is used to automatically rough- and finish-hob a gear in the same work cycle.

Two methods for distributing hob wear are available: continuous hob shifting (diagonal hobbing) and automatic increment hob shifting. With the latter method, the tangential hob slide is hydraulically clamped during the hobbing operation to provide maximum rigidity and accuracy.

The closed frame type of construction used in these machines is said to reduce the amplitude of vibration. The work-table slide and over-arm support slide are hydraulically locked during the cutting cycle. A large precision-made dual-lead worm-gear set is used for the work-table drive to provide accurate indexing of the work gear. A similar worm-gear set is also used for the hob spindle drive. Both worm-gear sets are provided with axial adjustment of the worm for backlash control.

Infinitely variable hob speeds are obtained by means of a motor-generator set and direct-current drive. Infinitely variable feeds are achieved through a PIV and step-gear drive. Accurate speed and feed settings are controlled by a simple hand-knob adjustment from the control station. Conventional or climb hobbing is selected by a push-button. Infeed accuracy is obtained through micrometer settings which assure exact duplication of depth of feed. Power is transmitted to the machine through a continuous flat belt.

The automatic lubrication system provides a constant flow of circulating oil which maintains a continuous oil film on the tapered bronze spindle bearing, thus insuring long life and accuracy of this vital member. Automatic lubrication of all moving parts is provided by a recirculating system. Special attachments for taper hobbing and for crown hobbing of spur and helical gears are available. The various models in this new line will handle gears having maximum diameters of 10, 16 (two models), and 24 inches.

Circle Item 567 on postcard, page 191

LeBlond 90-Degree Hydraulic Tracer

A 90-degree hydraulic tracer designed specifically for use on its heavy- and standard-duty lathes has just been announced by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This new equip-

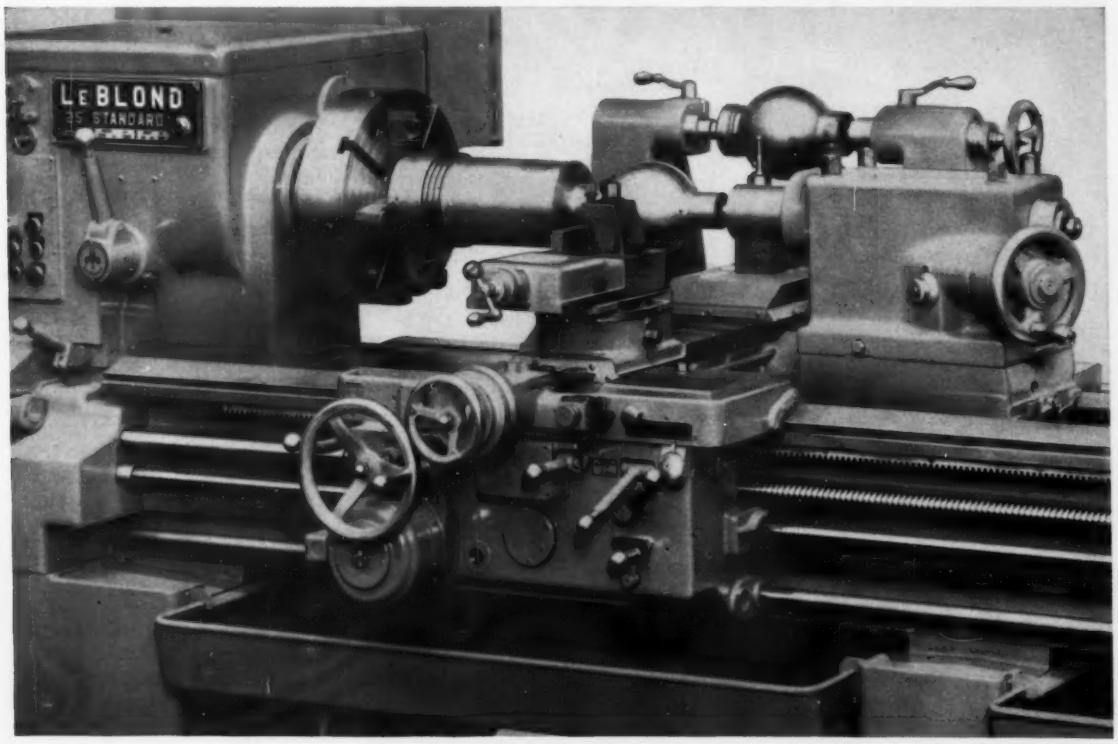


Fig. 1. LeBlond lathe equipped with new 90-degree hydraulic tracer

ment will trace from either flat or full, round templates. It is especially well-suited for tracer-turning stepped shafts, spindles, gear blanks, forming rolls, arbors, axles, cones, sheaves, pistons, and balls.

A master work-piece can be used for a template, or a flat template can be cut from inexpensive flat stock. The template is mounted between centers behind the work-piece, and the tracing stylus contacts it from below. As may be seen from the illustrations, there is no over-arm to get in the way or reduce the swing capacity.

When the tracer is operating, motion is transmitted directly from the tracer cylinder to the tool turret by a solid steel bar, the cross-slide screw being locked out of engagement so that it is not subjected to wear.

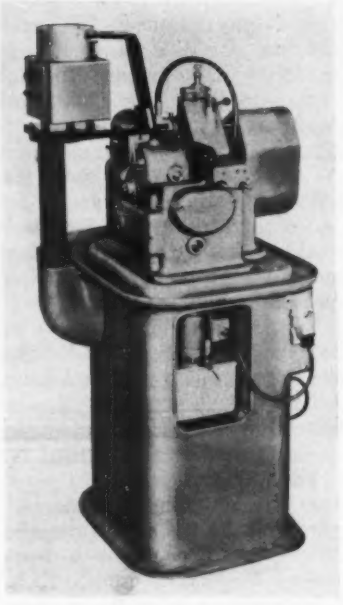
The tracer is designed for fast operation and is ruggedly constructed. It has in-and-out rapid traverse at rates up to 80 ipm (inches per minute) and variable hydraulic feed up to 45 ipm. Switching from tracer to standard operation or back again requires only thirty seconds. The tracer will resist pressures equal to 6000 pounds of cutting force at the tool tip, yet it is so accurate it will produce template contours faithfully to size within 0.001 inch on diameters and shoulder lengths.

Sizes and capacities are available for 16-, 20-, 25-, 32-, and 40-inch standard-duty and 13-, 16-, 20-, 25-, and 32-inch heavy-duty LeBlond lathes. In addition, LeBlond makes the Regal Trace, Hydra Trace, and LeBlond two-directional tracer.

Circle Item 568 on postcard, page 191

"Mikron" Hopper-Fed Hobbing Machine

Russell, Holbrook, & Henderson, Inc., New York City, sole representatives in the United States for "Mikron" machine tools, are introducing the Mikron No. 119 pinion-cutting machine of the hobbing type. This unit is now available with fully automatic hopper and magazine-feed equipment for cutting pinions of AGMA Class II precision accuracy with a tooth surface finish of 32 micro-inches. No skill is required to operate the machine, only occasional refilling of the hopper with pinion blanks being necessary. The machine has a capacity for handling pinion blanks 15/32 inch in diameter by 19/32 inch long.



Pinion-cutting machine introduced by Russell, Holbrook & Henderson, Inc.

The hopper is attached to a vibrator unit which moves the blanks along a guide rail that spirals upward inside the hopper of the magazine. The guide rail is so constructed that only pieces in proper position for cutting can enter the magazine. At the bottom of the magazine a loading device pushes the work-piece into the machine. It is gripped by a tailstock sleeve, then pushed into the operating spindle and clamped. The hob spindle moves into cutting position, and the slide moves forward. During the same period a completely automatic deburring tool, which is cam-driven and adjustable for the full machine capacity, moves into its operating position. The part is then cut; the hob rises, and the slide moves to its starting position. The deburring tool retracts; the work-piece is ejected, and the cycle is repeated.

Circle Item 569 on postcard, page 191

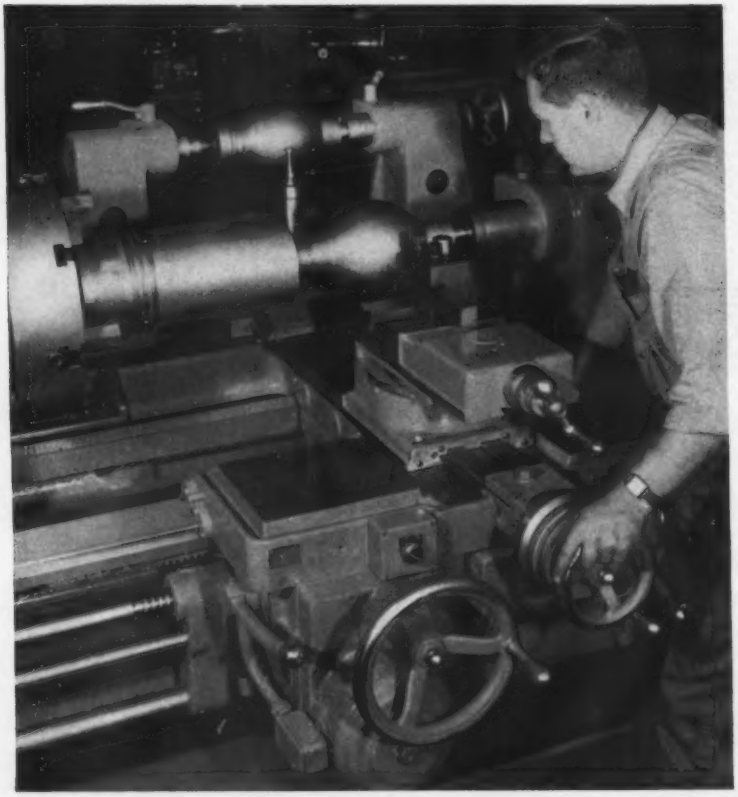
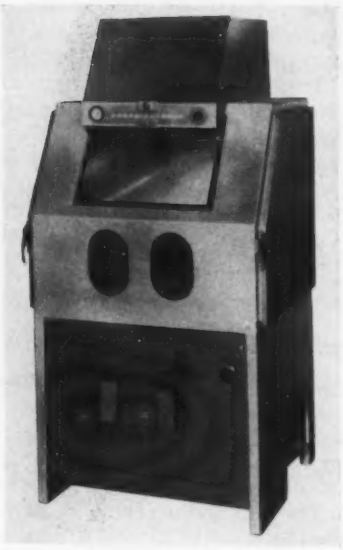


Fig. 2. Close-up of LeBlond lathe and tracer shown in Fig. 1



Perfecto-Peen machine for glass-jet peening process

Glass-Jet Peening Machine

A machine designated Model A-50 for use in a new process of glass-jet peening is announced by the Perfecto-Peen Division of Aero-Test Equipment Co., Dallas, Texas. This equipment uses specially treated, minute pure-glass beads in a slurry solution for peening, cleaning, and finishing metal surfaces. The processes not only increase the strength and fatigue life of metals but can also improve finishes down to 4 mu rms. Masking is not required down to and including a 4-mu rms finish. There is no imbedment or contamination of material surfaces. Further operations are eliminated. In addition, extremely delicate parts can be peened without altering critical dimensions. Hinged and feather burrs can be removed.

The machine is of welded stainless steel finished in two-tone gray. It is operated by a knee lever. A second knee lever controls washing of a 17- by 24 1/2-inch observation window. Holes in doors on each side of the working chamber permit peening long or bulky pieces. Special fixtures can be designed for semi-automatic production. The Model A-50 can be adapted for automated setups. Custom models can also be designed to suit any automation requirement.

All components are compactly installed in a cabinet fitted with standard plumbing and power connections. The machine has a sump containing the slurry solution of specially treated glass beads, a feed system powered by an external air supply, and a nozzle (gun) unit. No pump is required. A detachable drain tank on casters is located beneath the cabinet to collect overflow and to facilitate changes in glass bead sizes for different peening applications. Maximum flushing time for changing beads is thirty minutes.

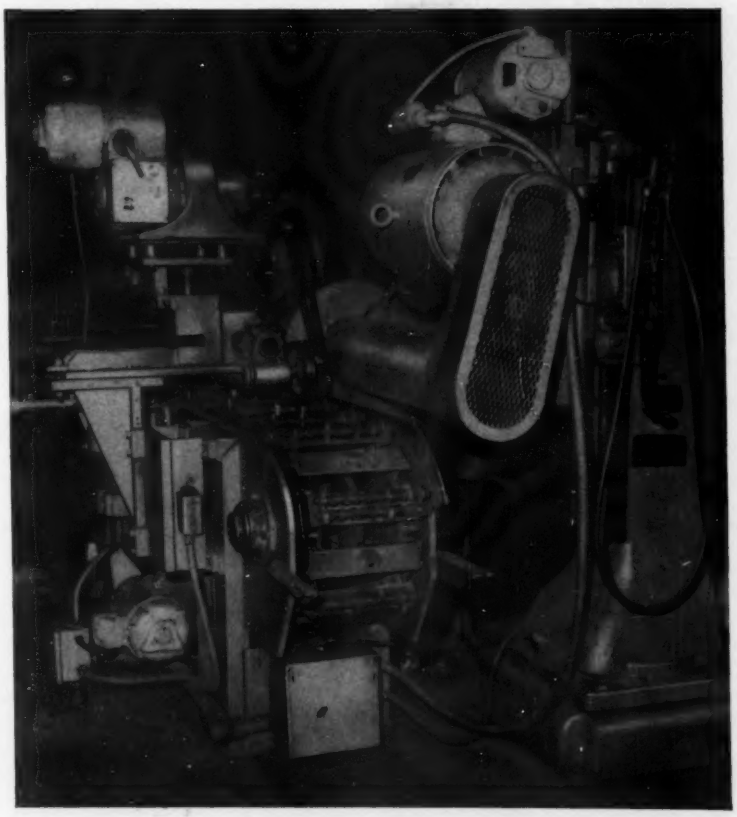
The machine is 7 feet 7 inches high by 3 feet 6 inches wide. It requires about 40 square feet of floor space with the doors open. Operating requirements are: 110-volt, 60-cycle alternating-current power supply, and compressed air at a pressure of 120 inches per square inch and minimum volume of 50 cubic feet per minute.

Circle Item 570 on postcard, page 191

Divine Straight-Line Production Grinder

A straight-line production grinder of special design was built recently by the Divine Brothers Co., Utica, N. Y., for the Utica Drop-Forge & Tool Division of the Kelsey-Hayes Co. The use of this machine has resulted in a significant reduction in the cost of producing precision turbine blades for jet engines. The metal alloy in the form of rods used for the jet blades is cut in dimensional sizes ranging from 6 to 18 inches. Before they are forged, these rods are upset by an Ohmes upset machine. With this equipment the rods are electronically heated by induction on one end and, at the same time, forced hard against a template so that as the end of the rod is heated a blob of metal is formed at the end of the rod. This blob comprises the root of the blade after forging.

To successfully form the blob on the upsetting machine it is neces-



Divine special grinder for chamfering rods for jet blades

sary to chamfer the end of the rod which is to be heated. Without this chamfer of 45 degrees, the metal would not form properly. In the past, the 45-degree chamfer was put on the rod in much the same way as sharpening a pencil by holding and rotating it by hand against a grinding wheel. This work generally required six men, each man producing approximately 360 rods an hour. Introduction of the new machine has cut the labor needed from six to two men.

When one man operates the machine, output per hour is approximately 1140 units, in contrast to the previous 360. The machine is geared to produce 2280 units per hour when operated by two men. It can also be used for any number of different operations with only minor modifications.

The grinder has two basic components: the conveyor and belt assembly, and the head units. Conveyor and belt are driven by separate, variable-speed motors. The conveyor, which carries the work, is fitted with nylon rollers on thirty-eight work stations around the circumference of the conveyor. Rods are laid in the work stations by hand because certain numbers of them must be faced to the outside. (This is to provide a reference to the lot in which this blade was made in case there is ever a failure of the blade.) The machine can be automatically loaded, however, if desired. The conveyor makes one complete revolution per minute.

The rods ride the conveyor under the belt assembly. The belt pushes the rods against the abrasive wheel, holding and turning them. The head units consist of three stationary grinding wheels, two of 36 grit, one of 46 grit. The 46-grit wheel is set last in sequence to provide a smoother polish on the finished chamfer. The head units are flexible and may be positioned as needed, up and down, to one side or the other. Control is by a push-button panel.

Circle Item 571 on postcard, page 191

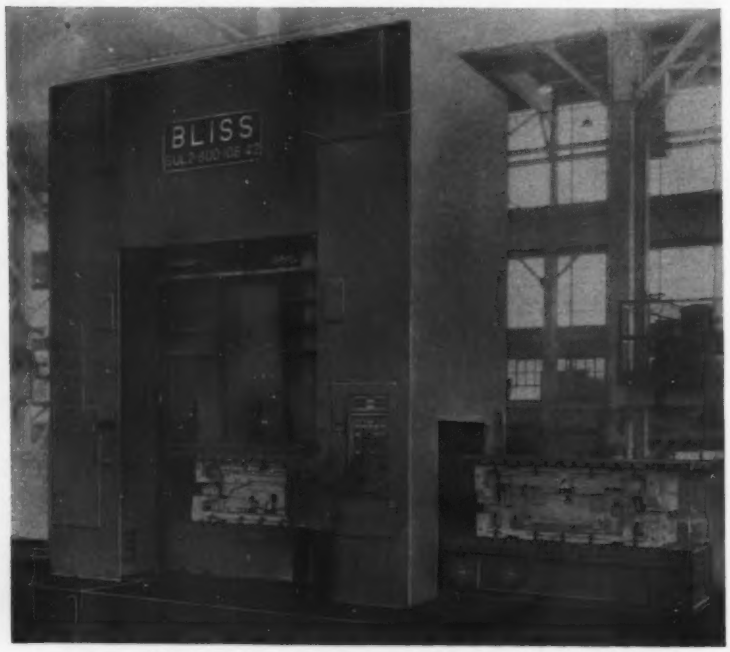
Bliss Press Built for Quick Die Changing

A press featuring unique devices designed to facilitate die changing is announced by the E. W. Bliss Co., Canton, Ohio. This is one of a line of presses being installed in an automotive plant to establish procedures for rapid changing of dies. It will permit a variety of parts to be made on a single line of machines without the necessity of a number of nonproductive hours between runs, during which time the dies in the line are changed from one part to another.

The press is equipped with two movable bolster plates, each of which can be rolled out through openings in the uprights of the press so that one is easily available for die changing by overhead cranes while the other is in production. With a new die in place on the inactive bolster, die changing simply involves rolling out the previously active die and rolling in the die for the new part.

The die space of the press is then automatically set within a thousandth of an inch by a Bliss electronic slide-adjusting system, and the new die is clamped instantly to the slide, using Bliss electro-pneumatic-operated die clamps. It is estimated that the entire procedure of die changing on a complete line of presses will take only minutes, compared to the hours required at present.

Circle Item 572 on postcard, page 191



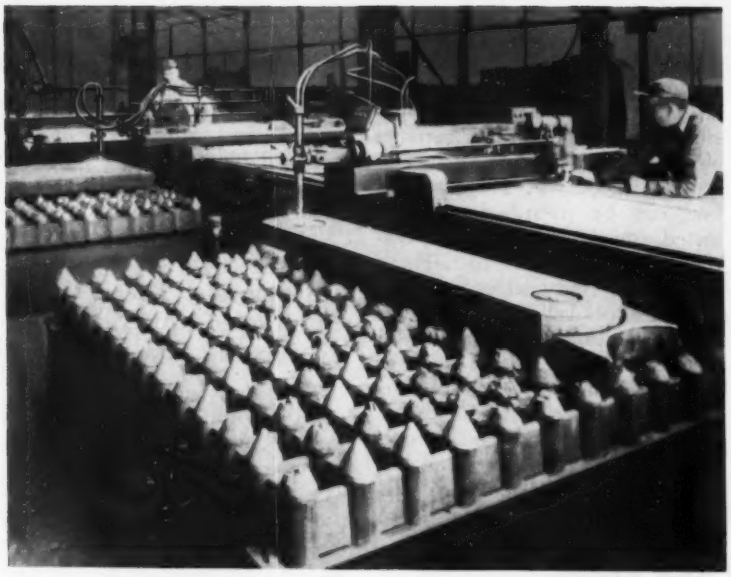
Press designed for quick die changing built by the E. W. Bliss Co.

Coolant for Maximum Work Visibility

A new coolant, said to provide for a high degree of work visibility, for both cutting and grinding operations where exceptionally fine tolerances are required, has been developed by Shear-Speed Chemical Products, Division of Michigan Tool Co., Detroit, Mich. Known as KLEER-60, the new soluble oil is an addition to the manufacturer's line of coolants and cutting oils.

Prepared as a concentrate, this coolant provides high penetration around the cutting edge of tool or wheel even at high cutting speeds because of its low surface tension, high extreme pressure characteristics, and superior wetting qualities. This aids in reducing friction and improving surface finish. Chip settling capacity is also said to be outstanding. KLEER-60 is nonfoaming, bacteriostatic and non-corrosive to copper, brass, aluminum, etc.

Circle Item 573 on postcard, page 191



Steelweld flame-cutting tables used for cutting steel from 1/2 inch to 12 inches thick

Steelweld Flame-Cutting Table

The Cleveland Crane & Engineering Co., Wickliffe, Ohio, is introducing a Steelweld flame-cutting table built for use in all shops that cut steel plate by means of a gas torch. This table was especially designed to overcome the high cost of repairing and replacing conventional tables used to support the steel plates during the flame-cutting operations. It is made of cast iron and machined to accommodate the cast-iron cones on which the plates rest while being cut. Cast iron is used for the cones because it has proved highly resistant to heat damage when employed for this purpose.

The cones provide considerable air space between a plate and the table, thus minimizing the intensity of the heat that reaches the table from a burning torch. Consequently, the table is seldom damaged. Only the cones are subject to injury when the flame strikes them, but because they are widely spaced, this occurs only occasionally. The cones are low in cost and easily replaced without using tools of any kind.

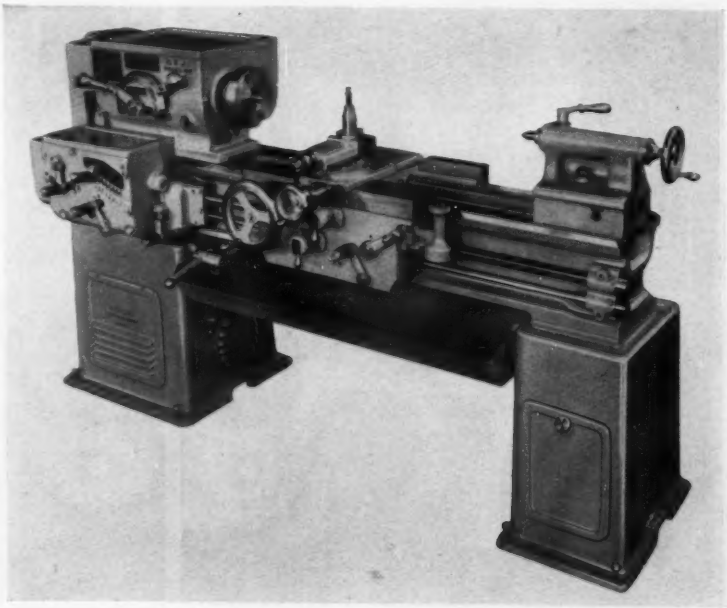
Flame-cutting tables have been used successfully in cutting steel plates and slabs varying in thickness from 1/2 inch to 12 inches. Extensive experience in cutting thousands of tons of steel indicates that the tables have practically unlimited life. Standard table sizes are 80 by 87 inches and 81 by 63 inches. Two or more tables can, of course, be fastened together to obtain larger table areas where desired.

Circle Item 574 on postcard, page 191

Geared-Head Engine Lathe

The Carroll-Jamieson Machine Tool Co., Batavia, Ohio, has announced a 16-inch geared-head engine lathe, known as the "Master Model GH." This machine is designed to give big-lathe performance at comparatively low cost. A 5-hp motor is conveniently mounted in the cabinet leg with multiple V-belt drive to the headstock V-pulley. The all-geared headstock is designed for convenience, power, and durability. It has twelve spindle speeds, ranging from 20 to 900 rpm, obtained through two speed-control handles. Accurately ground steel shafts and heat-treated alloy-steel gears are provided. A standard LO type taper-nose spindle, or an optional threaded-nose spindle, is mounted in precision Timken taper roller bearings.

An improved friction type clutch and brake affords instantaneous spindle control, allowing the motor to run continuously. Lubrication of the headstock is by splash system, the parts running in a constant oil bath. A quick-change gear-box has provision for cutting forty-eight separate threads and furnishes forty-eight feeds. From 3 to 184 threads per inch can be cut through operation of the gear-box levers. A quadrant accommodates



Carroll-Jamieson geared-head engine lathe

gears for cutting special threads. A clutch lever controls lead-screw and feed-rod, which cannot be engaged simultaneously. A neutral position is also provided which permits the disengagement of both screw and rod.

The double-wall apron employs all-steel and ductile gearing. Separate lever type longitudinal and cross-feed clutches are supplied. The reverse mechanisms for both feeds is operated by a conveniently positioned lever. A separate rod is used for the feed, the lead-screw being used only for thread chasing. An interlocking device prevents simultaneous engagement of the lead-screw unit and clutch feed. The feed-rod is equipped with a spring-loaded positive type safety clutch to provide feed release under overload.

The heavy cross-ribbed bed is made of first-grade, gray-iron, semi-steel metal of close-grained composition. Both front and rear carriage V-ways are provided as well as an inner tailstock vee. The standard bed can be furnished with inserted, ground and hardened carriage V-ways at extra cost. These V-ways are replaceable and have a 64-66 Rockwell C hardness. A large assortment of additional equipment is available.

In addition to the geared-head 16-inch lathe, the manufacturer also builds a similar 18-inch model. Both of these lathes are available with short, medium, or long beds.

Circle Item 575 on postcard, page 191

Expanded Line of KRW Presses

The redesigned and modernized line of straight-side, single-action hydraulic presses manufactured by K. R. Wilson, Inc., Arcade, N. Y., has been expanded to cover a range of 25 through 1000 tons. These machines can be used for a wide variety of operations, including trimming, bending, forming, blanking, briquetting, broaching, coining, embossing, forging, and straightening. They are of rigid, welded-steel construction and have the frame members keyed and fitted together to insure maximum resistance to deflection. Angle-gibs located at each corner of the platen insure platen-to-bed parallelism.

The compact hydraulic systems can be mounted at the top of the press or furnished for floor installation. Safety is provided by a counterbalance valve which prevents the platen from dropping through loss of pressure in the system, or because of excessive die weight. All forty-eight models are available with either up-acting or down-acting platens, constant-speed or variable-speed pumping systems, and manual-lever or electric push-button controls for single or continuous cycling of these modernized machines.

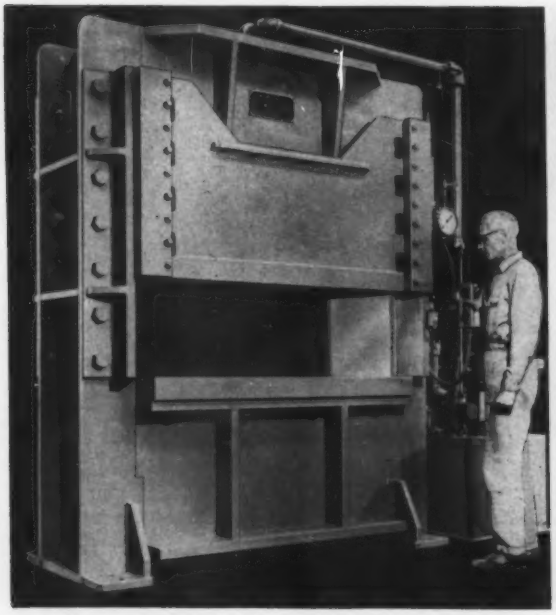
Circle Item 576 on postcard, page 191

Burgmaster Turret Drill Equipped with Tapmatic Tapping Attachments

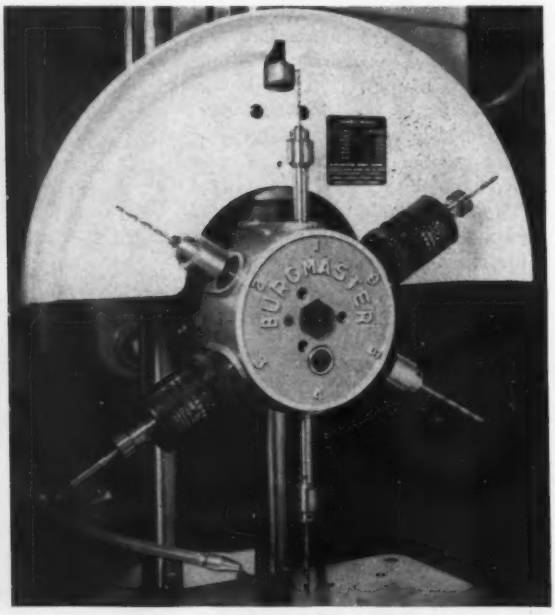
The Burgmaster Corporation, Gardena, Calif., has announced that No. 00 to No. 10 as well as No. 0 to No. 6 tapping attachments made by the Tapmatic Corporation, Costa Mesa, Calif., are now being used to good advantage on the Burgmaster six-spindle turret drilling machines.

The Burgmaster "3000" tapper, manufactured by the Corporation, has a supersensitive driving torque adjustment and a floating spindle designed to assure high production of consistently accurate threads by operators of minimum skill. It is claimed that the unit can operate continuously at speeds up to 2500 rpm with virtually no tap breakage even when using the smallest size taps in blind holes.

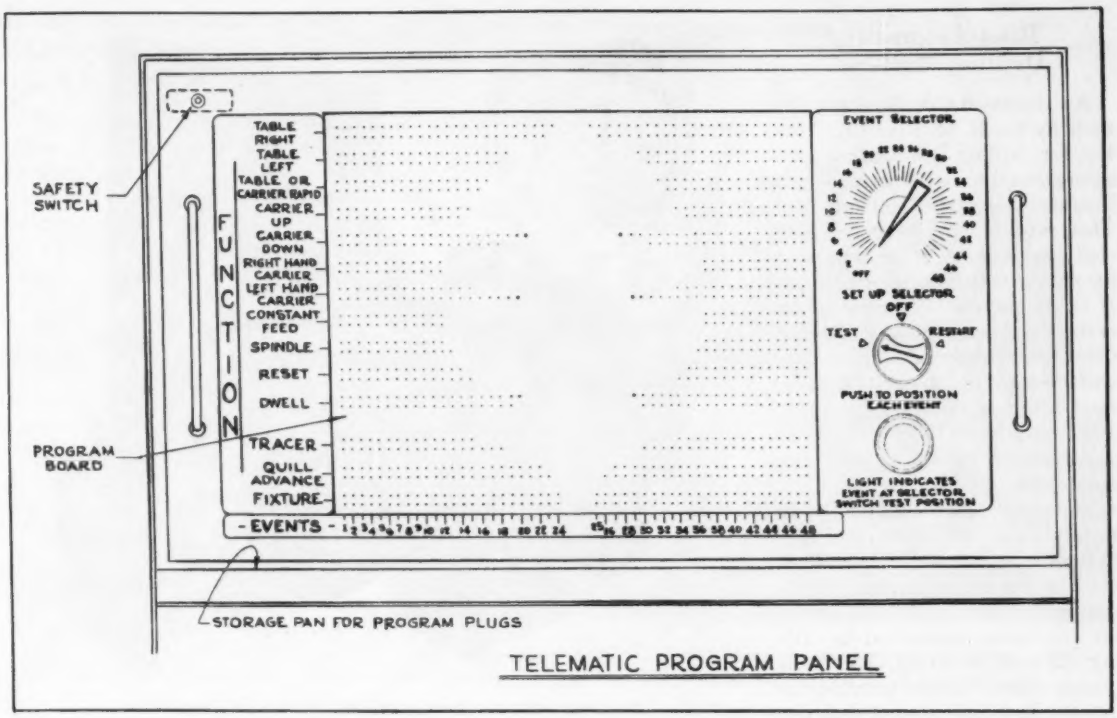
Circle Item 577 on postcard, page 191



Wilson straight-side, single-action hydraulic press



Turret drill equipped with Burgmaster "3000" tapper



Cincinnati Telematic control that provides simple pegboard setup for milling machine automatic cycles

"Telematic" Automatic Control for Milling Machines

A greatly simplified automatic milling machine cycle control called the "Telematic" has been introduced by the Cincinnati Milling Machine Co., Cincinnati, Ohio, for use with its 200 series Hypowermatic milling machine. The control panel, a simple pegboard in appearance (shown in the illustration), controls all functions or movements of the machine and auxiliary operations such as fixture clamping or indexing. For each machine function there is a row consisting of twenty-four holes that allow the operator to "peg-in" complex, automatic milling cycles involving up to twenty-four steps or events. If desired, pegboard panels for more than twenty-four events can be supplied to suit special requirements.

Setup consists of inserting plugs in holes opposite the name or title of each desired function on the pegboard in the proper sequence. Trip-dogs, positioned on the machine table and spindle carrier, initiate each new action and the Telematic control directs the action. The machine functions that can be programmed are: table right or left; table or carrier rapid; spindle carrier up or down; constant feed for accurate stop; dwell; quill advance; tracer control; spindle rotation; fixture control; and reset. A stepping switch scans the control board one step at a time and initiates all functions indicated by the placement of pegs. When the relay scans "reset," it automatically returns to its initial point ready to start a new cycle.

To simplify setup, a switch is provided which positions the machine elements to any selected point in the cycle. A push-button initiates the next action without waiting for the trip-dog to function. If, during the operation, the operator wishes to determine where the machine is in its cycle, he need only turn the selector switch; the panel light will come on when he has reached the active event. The operator may also stop the machine at any part of the cycle and resume it without returning to the original starting point.

Tracer control can be programmed into the cycle as simply as any other machine function. Accurate stop control within 0.001 inch can be pegged in as an automatic function. A further advantage of Telematic control is that several depths of cut can be made in single cycle even if trip-dogs must be bypassed to reach the required depth. No trip-dog is activated unless its function is pegged in the control board for that particular event in the operating cycle of the machine.

When it is necessary to follow one event very closely with a second one, the trip-dog for the second event is set in a different T-slot and will actuate its event even though the first-event trip-dog is still partially depressing its plunger. This arrangement serves to allow sufficient space between the trip-dogs to facilitate accurate setting.

Templates, with only holes punched to program a specific job, can be superimposed over the Telematic panel. Cincinnati will provide either these or unpunched templates. Templates punched to program specific jobs can be stored to facilitate setup for reruns.

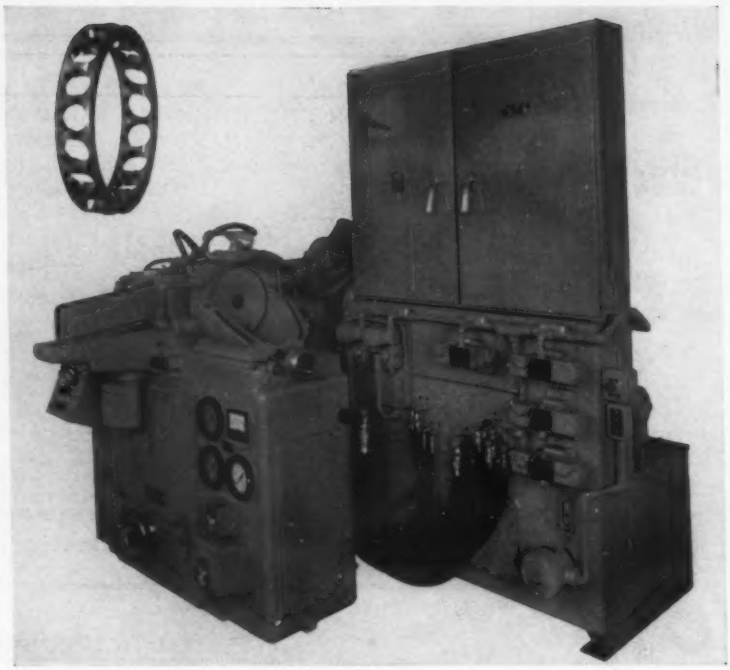
Circle Item 578 on postcard, page 191

Root Automatic Drilling Machine

An automatic drilling machine built by the B. M. Root Co., York, Pa., for drilling ball-bearing separators is said to have increased production more than 550 per cent. This machine is designed especially to drill cages or separators for precision ball or roller bearings. It is completely automatic in operation and has adjustments to provide for drilling separators in a wide range of sizes. The index mechanism is extremely accurate. Any number of holes can be accommodated by simply changing index-plates.

All operations are performed hydraulically, including the rotation of the spindle. This allows extreme flexibility in selecting the proper spindle feeds and speeds for maximum production in drilling different materials. The push-button control station provides for independent operation of each motion of the machine to facilitate setup. Interlocks prevent damage to the machine or parts.

Silicon-iron-bronze separators requiring twenty-two holes, 0.718 inch in diameter by 0.560 inch deep, are drilled accurately to depth at the rate of forty-five separators per hour. The previous production rate was only eight per hour. A better micro-inch finish was also given the ball pockets by the new machine. Bronze separators from 4 to 10 1/2 inches in diameter with a minimum width of 11/16 inch can be drilled with a 1 3/8-inch drill.



Machine for automatically drilling ball-bearing separators

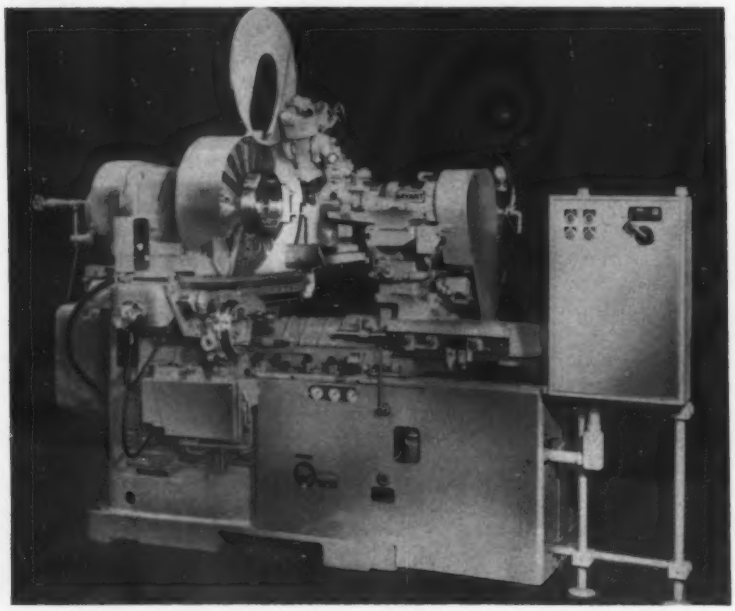
Circle Item 579 on postcard, page 191

Ball- and Roller-Bearing Raceway Grinder

The Bryant Chucking Grinder Co., Springfield, Vt., has announced the availability of its 1124-JY internal grinder. This versatile machine is designed for grinding ball- and roller-bearing raceways in outer bearing races and straight bores in inner bearing races ranging from 1 inch to 20 inches in diameter. The change-over from one job to another can be accomplished quickly.

Work parts are held in a shoe type centerless fixture which incorporates a rotary electromagnetic chuck having a 21-inch magnetic driver with eighteen adjustable pads. The machine shown here is equipped with a special wheel-face dresser which trues the wheel for simultaneous plunge grinding of both the inner faces and bore in roller-bearing outer races. A radial diamond-holder forms the wheels used for raceway grinding.

Circle Item 580 on postcard, page 191



Bryant internal grinder designed for processing bearing raceways

Buhr Combination Machine Designed for Processing Truck Flywheel Housings

The simple, compact Economatic shown in Fig. 1 was built from standard components by the Buhr Machine Tool Co., Ann Arbor, Mich., for the machining of truck flywheel housings. This simple, shuttle type unit shows how low-production processes can be employed to reap the benefits of automation without investing money in expensive equipment. The machine automatically drills, chamfers, and taps a series of holes, first on one side and then on the other side of the housing—all with a single hydraulic feed unit. To accomplish this, the part is mounted on an indexing table, as shown in Fig. 2. The indexing table is then shuttled through the machine. After the holes on one side of the part are drilled, chamfered, and tapped, the table automatically indexes 180 degrees and shuttles back to the first station. The table then goes through again to permit drilling, chamfering, and tapping the holes on the other side of the part. The machine thus performs six sets of operations although it has only three stations. Although only one hydraulic feed unit is used, there is automatic changing of strokes for drilling, chamfering, and tapping.

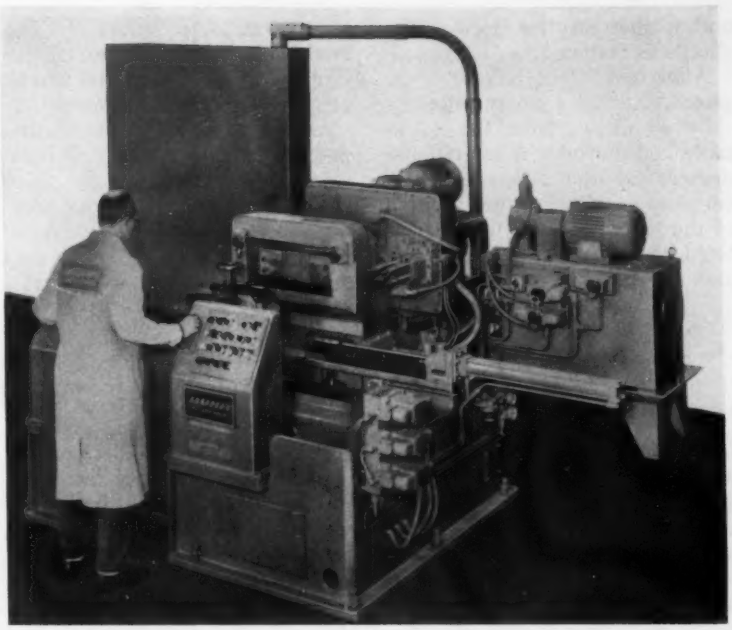


Fig. 1. Combination shuttle-dial machine designed by Buhr Machine Tool Co. which performs six sets of operations with a single hydraulic unit

Because standard components are used in simple combinations as in transfer machines, this equipment can be easily converted to meet part design changes or to process an entirely different part. Several simple time-tested techniques have been combined in its design so that it operates automatically even though the production rate is low.

Work-pieces are drilled in the same station where they are manually loaded and clamped in the simple fixture. They are then successively positioned in the chamfering and tapping stations by movements of the shuttle. Since four bracket holes are required on each side of the housings, the work-piece has to be turned 180 degrees in the horizontal plane to present the second side to the tooling. Referring to Fig. 2, tools, in groups of four, are fed from the right and enter the part as it stops at each machining station. In the foreground are shown, from left to right, a pin that pulls the index-pin on the dial, the rotating slip coupling that rotates the dial table,

Fig. 2. Work-pieces are held in a simple fixture mounted on an index-table which in turn is mounted on a shuttle of the Buhr machine shown in Fig. 1

and a shot-pin that locates the shuttle in Station 2.

After one set of holes is completed, the index-pin is automatically withdrawn from the index-table and the table is rotated 180 degrees by the rack-driven slip coupling engaged with the shaft of the dial. After the table is rotated, the index-pin is re-engaged and the shuttle returns against positive stops in Station 1. The machining cycle is repeated as the shuttle again carries the work-piece past the tools. At Station 3, after the taps have been withdrawn, the table is rotated back to its initial position and the shuttle returns to the load-unload position. The complete automatic cycle time is 1 4/5 minutes.

Circle Item 581 on postcard, page 191

Three-Way Balance Milling Machine for Processing Connecting-Rods

The Snyder Corporation, Detroit, Mich., has developed a three-way precision balance milling machine that weighs and machines automotive connecting-rods to a plus or minus 1/16-ounce weight tolerance at a production rate of 313 parts per hour. The extreme precision in weight of parts produced on this equipment is the result of an electronic-memory weighing system that accurately controls the depth of feed of the machining units; and a method of providing electrical compensation in the depth control of a drill spindle. This electrical-compensation system accurately allows for variation in metal removal caused by the point of the drill.

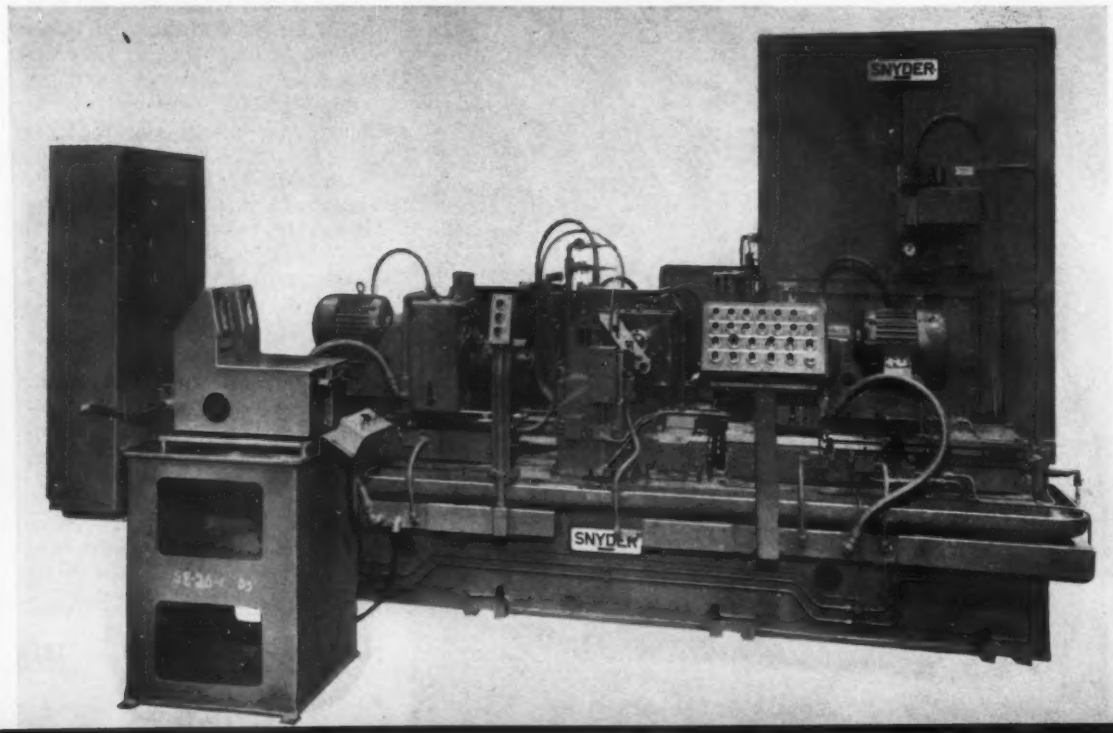
The machine consists essentially of three Snyder standard machining units mounted on a one-piece, three-way base. Two of the units oppose each other and each carries single-spindle hollow-mill heads driven by 3-hp motors. The third unit operates at right angles between the other two opposed units. It carries a single-spindle drill head driven by a 3-hp motor. Two weighing scales simultaneously weigh each end of the connecting-rod and set up a memory system that controls the depth each spindle must feed to remove the correct amount of metal. The weighing scales are conveniently mounted on a base at the side of the machine.

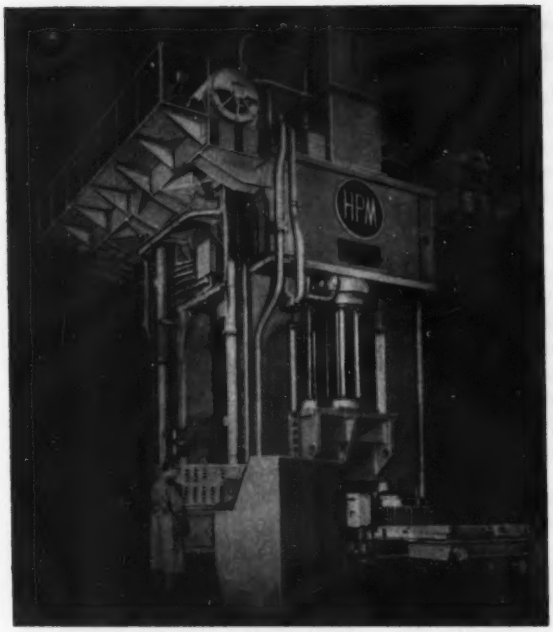
During the machinging operation, a connecting-rod is clamped in a stationary position. The opposed hollow-mill units remove stock from the bosses on each side of the crank end of the part while the other unit drills a hole in one side of the boss on the wrist-pin end.

A connecting-rod to be precision-weighed and machined is first placed on the weighing scales. It is then removed from the scales and loaded into the fixture on the milling machine. The cycle buttons are then pressed, causing the part to be clamped and the machining functions of all three machining units to be initiated. Each unit rapid-advances and feeds against stops. Hydraulic cylinders cause the stops to retract and the unit to feed a cutting tool into the part until an electronic balance is achieved between the depth control of the unit and that of the memory system. Any unit that is required to feed past the minimum part-machining dimension goes into an emergency return and causes a light on the machine-control panel to indicate that a part is being rejected. Since the memory system in the weighing scales enables a reading to be stored for the machining operation, a part can be weighed while the preceding one is being machined.

Circle Item 582 on postcard, page 191

Snyder connecting-rod balance milling machine that enables parts to be produced to close weight tolerances





Huge press built for Hidraw forming process by the Hydraulic Press Mfg. Co.

Ther-Monic induction heater for brazing work built by Induction Heating Corporation

H-P-M Press for "Hidraw" Forming Process

The largest press ever built for the "Hidraw" forming process was completed recently by the Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, a division of Koehring Co. It has a 7500-ton downward-acting slide with a 60-inch stroke and is equipped with a 6750-ton die cushion which has a 26-inch stroke. The pressing area is 72 inches by 144 inches. Maximum closing speed to the work and the return speed is at the rate of 600 inches per minute. Pressing speed to full tonnage capacity is from 4 1/2 to 47 1/2 inches per minute.

The press is powered by the H-P-M closed circuit "Fastraverse" system with full electrohydraulic servo controls, including all conventional type control plus regulation of die-cushion pressure to the pre-set pressure-position pattern. Every sequence of press operation and numerous safety devices are indicated by pilot lights on the control console. Actual positions of the main ram and die-cushion rams are shown at all times by meters on the control console.

In the event of power failure or loss of hydraulic pressure, a safety device stops the press slide.

Electrohydraulic servo-controlled work-loading tables are part of the press equipment. Several of these tables are used for loading and unloading the work by employing an overhead crane. Current production dies are mounted on the tables which are used as needed and are moved to and from their storage racks to the press by a carriage which travels on tracks. This carriage also acts as a base for the loading table while it is in use. Sequencing of the table movements in and out of the press is completely automatic and is part of the press cycle. Pilot lights on the console show the operating sequence of the table and press.

The design of the hydraulic system makes it possible to isolate any one of the pumps from the hydraulic circuit by means of a push-button on the operating console. Also, the functional operation of two pumps can be interchanged.

The over-all height of the press is 47 1/2 feet with 15 feet below and 32 1/2 feet above floor level. It weighs approximately 1,500,000 pounds and takes approximately 5000 gallons of hydraulic oil for operation. Total connected horsepower rating is 1610.

Circle item 583 on postcard, page 191

Portable Induction Heater

Work-heating coils can now be brought to the work up to a distance of 50 feet from the generator with a remote-operated, dual-output induction heater introduced by the Induction Heating Corporation, Brooklyn, N. Y. This portable unit can be applied to a wide range of work. It makes it possible to bring the heating coils to the work, in contrast to conventional procedures where the work has to be brought to the work-heating coil. The mobility of the coils is a particularly desirable and valuable feature where the work-pieces are large, cumbersome, unwieldly, or immovable.

The first units were especially designed for and currently are in full-scale production service at major aircraft manufacturing plants, for brazing fuel and hydraulic lines and fittings inside the bodies of airplanes. The induction unit and its accessory equipment are shock-mounted on a rugged, mobile platform, and can be towed to the place of operation at speeds up to 15 mph.

The Ther-Monic unit comes complete with dual-output station and required controls for accessory equipment and each remote sta-

tion. Two flexible, low-loss, high-frequency coaxial cables furnish power to two work-heating coils in different parts of the plane—performing alternately, each handled by its own operator. When the brazing operations in various sections of the plane are completed, the gear is readily moved on to do its work in the next plane on the production line. Only the input power cable must be disconnected before moving the entire unit to the new position.

The remote-control stations are of the pendent type and are located alongside the operator for convenience when in use. Electrical interlocks on each coil prevent concurrent operation, and an indicator light shows which coil is in use.

The fuel and hydraulic lines currently being brazed by Ther-Monic's portable unit are stainless steel and vary from 1/2 inch to 3 1/2 inches in diameter. High-quality, scale-free joints are assured by the application of inert atmosphere from the gas tanks carried on the heater's mobile platform.

Circle Item 584 on postcard, page 191

Production and Toolroom Honing Machine

A Model "J2" honing machine, designed for production runs, as well as toolroom work and salvage operations, has been announced by the Superior Hone Corporation, Elkhart, Ind. It provides infinitely variable spindle speeds from 225 to 525 rpm or an optional range of 450 to 1050 rpm and is powered by a 1/2-hp, 110-volt, 60-cycle, single-phase motor.

The complete drive, motor, and coolant tank are enclosed in the heavy steel base, the cover of which is louvered to permit adequate ventilation. Also featured are a tray top, sealed ball-bearing spindle, splash guards, and anti-splash screen located in the coolant tray.

The 14-gallon coolant tank is removable for easy cleaning. All wiring connects to the main outlet box so that but one extension cord is required. Optional equipment includes a dial indicator, full-width extension tray, and filter tray with three settling baffles and burlap filter.

Circle Item 585 on postcard, page 191

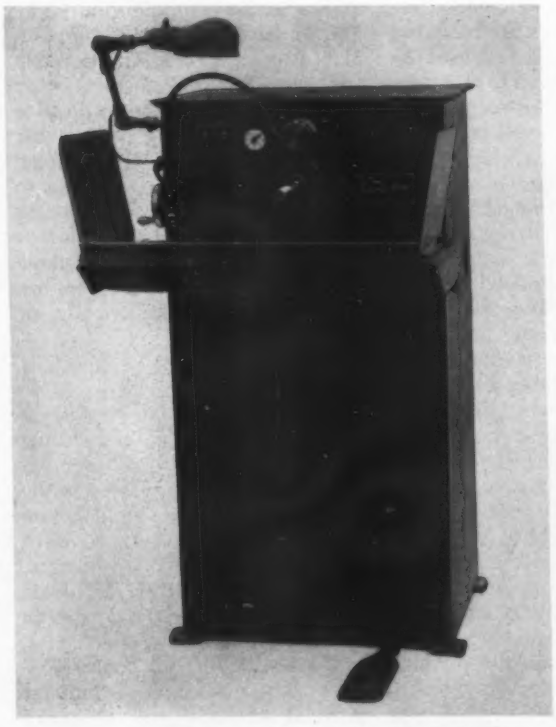
Dickerman Self-Contained Stock Straighteners

A line of stock straighteners available in six models has been introduced by the H. E. Dickerman Mfg. Co., Springfield, Mass. Enclosed in a steel cabinet base and capable of 20 to 80 feet per minute stock feed, the new units hold stock at a height of 40 inches from the floor and occupy a floor space only 17 by 22 inches.

This stock straightener handles coiled stock 4 to 10 inches in width and 0.020 to 1/8 inch in thickness. It is available with five or seven straightening rolls and with motor ratings of 1/2 to 1 hp. The straightener is completely self-contained within its own roll-about cabinet which is easily portable from one press to another.

Each model has variable-speed control which permits setting the operating speed at the most suitable point for automatic feeding of the press. Models are also equipped with two motor-driven pinch rolls which drive all lower rolls. Upper straightening rolls are individually adjustable.

Circle Item 586 on postcard, page 191



Honing machine announced by Superior Hone Corporation

Stock straightener introduced by H. E. Dickerman Mfg. Co.

Torc-Pac press of 60-ton capacity

Clearing Torc-Pac O.B.I. Press

Clearing Division of U. S. Industries, Inc., Chicago, Ill., has recently added a 60-ton capacity machine to its present line of Torc-Pac open-back, inclinable presses, formerly available only in 22-, 32-, and 45-ton sizes. These presses are built on the "modular" principle, that is, each press is composed of three basic units consisting of the frame, drive, and head. Because these units are completely interchangeable, they are being used to solve many problems of maintenance and obsolescence. As an example, a replacement drive can serve as a standby unit for an entire shop full of presses.

With regard to obsolescence, the drive and head units (which comprise all parts of the press except the frame and the base) can be used in any special press application. One manufacturer has installed a Torc-Pac drive and head on a girder in his building in order to accomplish an operation where a normal press could not be used.

The 60-ton Torc-Pac press, like its smaller predecessors, has a unique air-friction clutch in which bronze friction plates are used rather than conventional asbestos-neoprene type liners. The friction plates operate in a sealed-in-oil enclosure. The oil is used, not merely to lubricate and dissipate heat, but to absorb the shock of the "pick-up" load during engagement. When the clutch is engaged, oil is momentarily trapped between the moving and stationary clutch and brake plates. The sudden closing of these plates places the oil in "shear." Before it can escape completely, the oil starts the engagement of the clutch—or conversely, the setting of the brake.

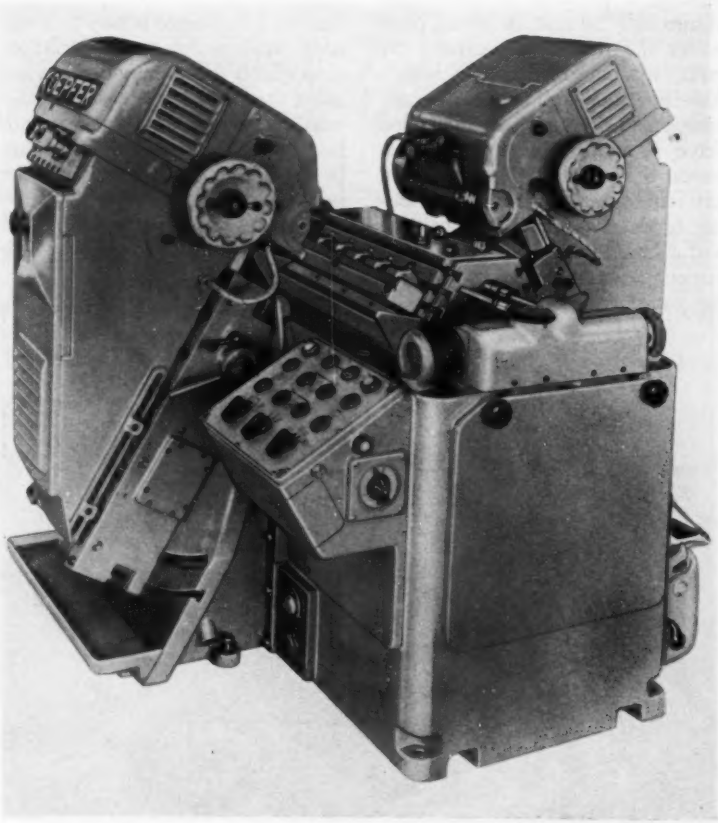
Circle Item 587 on postcard, page 191

Koepfer Rack-Cutting Machines

The Cosa Corporation, New York City, has recently added two Koepfer rack cutters to its line of specialized automatic production equipment. These machines are designed to produce racks for all types of office, tool, and scientific machinery—from simple typewriters to complicated electronic computers.

Two models are available: the 205 and the 210. Model 210 has a larger cutting-length capacity. A second cutting head may be added at any time to double production rates. Various cutting tools are available, from a single to a gang of annular form cutters. Cycling is precise and automatic. Plunge cutting, climb milling, dimensional milling, traverse feed, and infeed are automatically controlled through a built-in selector panel. Skip milling is done through a special cam mechanism. The built-in, quick-set indexing device is said to be extremely accurate.

Fast traverse of the cutting heads and the work-table, together with the combination of plunge-longitudinal feed, reduce the cutting cycle to a minimum. Spindle speeds are adjustable from 80 to 645 rpm.



Rack-cutting machine introduced by the Cosa Corporation

Work-table surfaces are slanted 30 degrees to simplify setting up and disposal of chips and coolant. They are wide enough to take several work-pieces at one time. The cutting head swivels 20 degrees to either side of the line of traverse to produce skew racks.

The maximum cutting length on the 205 model is 20 inches and on the 210 model, 40 inches. Maximum cutting width is 4 inches. Rack teeth up to 6 diametral pitch can be cut in steel and up to 5 diametral pitch in cast iron.

Circle Item 588 on postcard, page 191

Horizontal Barrel-Finishing Machine

An extremely rugged horizontal barrel-finishing machine named the "Finishmaster" is being manufactured by the Baird Machine Co., Stratford, Conn. This machine has 1/4-inch steel plate on the frame and requires a floor space of only 5 square feet.

The lightweight doors of armor plate can be lifted by hand and all loading and unloading equipment can be carried over the top of the machine since it is less than 4 feet high. The barrel guard swings out of the way to make the opening accessible for loading.

The controls on the Finishmaster are at the front of the unit, making it possible to place machines side by side. A lifting plate under the drive unit permits the entire machine to be raised with a fork-lift truck and moved to any location desired. A variable-speed drive provides barrel speeds between 8 and 24 rpm for finishing any material. A built-in brake motor holds the barrel in position, and a limit switch permits jogging but not running of the barrel when the guard is raised.

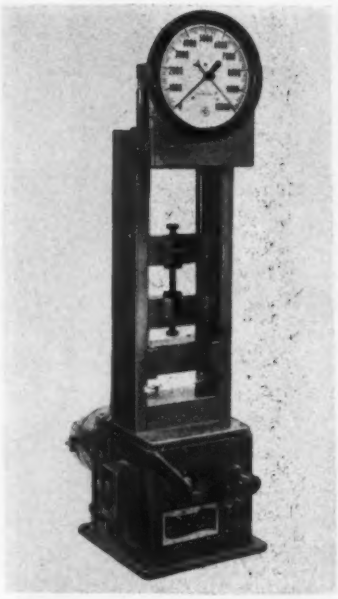
Standard equipment includes an automatic timer, an automatic pressure-relief valve in the cover, barrel-speed controls, and a drive with helical-gear speed reducer.

Circle Item 589 on postcard, page 191

Balancing Instrument

The Morehouse Machine Co., York, Pa., has announced that redesign of its calibrating and weighing system balancing instrument has resulted in a new standard of performance and stability. An extremely sensitive miniature cam, spring-loaded for positive adjustment, has replaced a potentiometer as the zero-adjustment device. This device is said to eliminate undesirable phase-relationship effects which may occur when using the potentiometer in a phase-sensitive instrument. The zero adjustment also eliminates an algebraic subtraction in obtaining the proper reading. A vacuum tube and Morehouse proving ring are used with the instrument which operates on 110 volts.

Circle Item 590 on postcard, page 191

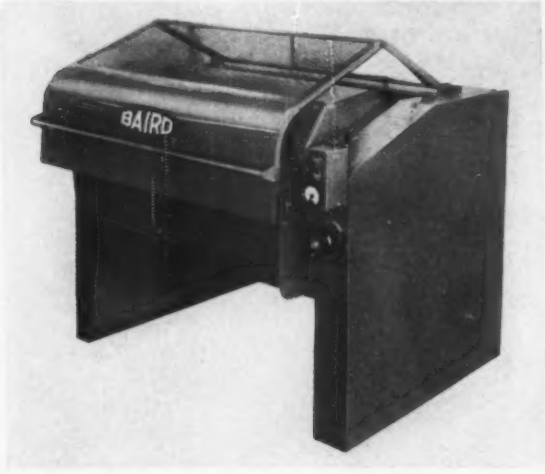


Standard Steel City Model TE-10 bench-mounted tensile tester

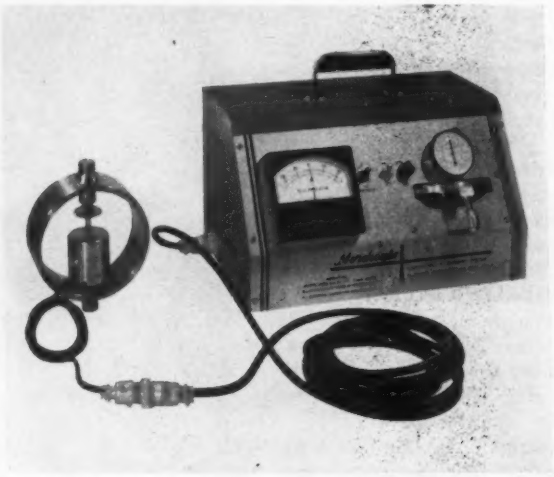
Tensile Testing Machines

Two completely new tensile testing machines will be exhibited at the Metal Show by Steel City Testing Machines, Inc., Detroit, Mich. One is a bench-mounted model (illustrated) and the other is a portable unit. Both of these testing machines have several sizes and styles of specimen-holding jaws that cover a wide range of flat and cylindrical specimens. Capacities of these models range from 1000 to 40,000 pounds.

Circle Item 591 on postcard, page 191



Baird "Finishmaster" compact barrel-finishing machine



Calibrating and weighing system balancing instrument

Stock Thickness Gaging and Recording Instrument

The Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation, has developed a pneumatic gage recorder for laboratory and production inspection work that charts thickness deviation simultaneously with the gaging of sheet stock. This equipment detects and records high and low spots in steel, aluminum and plastic sheets, missile skins, and precision stampings.

According to present industry practice, gaging the thickness of a 5-foot-long sheet with a mechanical gage at 1/2-inch intervals along the theoretical center line and the recording of plus and minus deviations from the nominal size require 120 gage adjustments, 120 gage readings, and 120 separate listings of deviation signs and multiple numbers. After this has been done, the profile chart or size certificate must still be manually prepared.

With the pneumatic gage recorder illustrated, no gage adjustments or hand-written figures are required. The operator simply moves the size-sensing element along the sheet, or moves the sheet through the gage head, and the size deviation is automatically charted on a 4-inch-wide strip chart. Chart travel is either intermittent or continuous, being operator-selected by means of a switch. With the index drive, approximately 1/8-inch length of chart is required for each gage reading. Standard chart speeds are 1, 2, or 6 inches per minute or 9 inches per hour. Other chart speeds are available on special order.

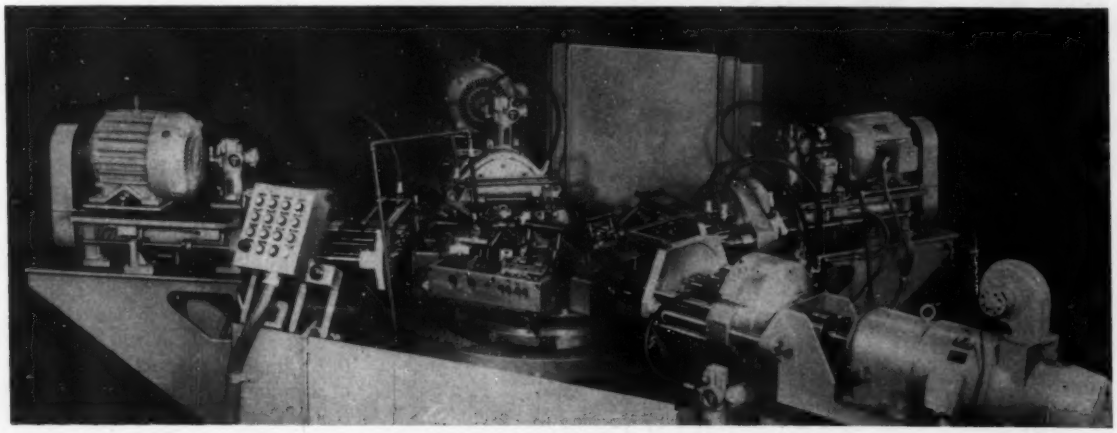
Sheffield pneumatic gage recorder for checking stock thickness

Both contact and noncontact air-gage tooling can be used with the pneumatic gage recorder which offers a full scale tolerance range from ± 0.0003 to ± 0.040 inch with proper tooling. Because the instrument accommodates interchangeable tooling, internal as well as external dimensions can be inspected. A two-dimension unit with two scribing pens is also available. The combination air-gage recorder can also be used with spindles for checking bores and with fixtures for charting various dimensions.

Circle Item 592 on postcard, page 191

Zagar Machine Equipped to Process Brake-Wheel Cylinder

Thirteen different jobs, all with different hole patterns, are drilled, countersunk, reamed, and tapped with the same four heads on a machine announced by Zagar, Inc., Cleveland, Ohio. This unusual setup is accomplished by having three different sub-plate-mounted, removable tables. Each table has five stations—four working and one load-unload. Four parts are loaded in a jig at each station.



Brake-wheel cylinder processing machine announced by Zagar, Inc.

The station sequence is: (1) drill, (2) drill and countersink, (3) ream and spot-face, and (4) tap, by individual lead-screw for close depth. In all, sixty-one holes are processed.

Ordinarily more heads and stations would be required to process this number of holes, particularly where such close center machining is necessary. Heads are fed by a 7 1/2-hp, 10-inch stroke Zagar unit. The cycle is completely automatic, with manual loading and unloading. Production for this machine is at the rate of 700 pieces per hour.

Circle Item 593 on postcard, page 191

Heavy-Duty Hydraulically Driven Band Saw

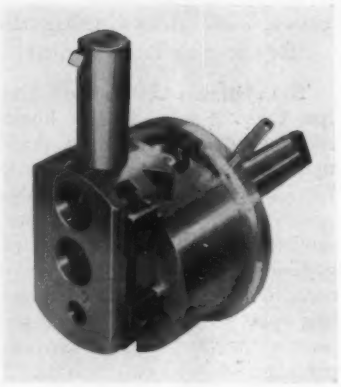
The Machine Tool Division of Kalamazoo Tank & Silo Co., Kalamazoo, Mich., has announced the addition of a completely hydraulic, heavy-duty machine to its line of horizontal band saws. This Model 14A band saw, called the "Big K," is said to offer exceptional cutting capacity at comparatively low tool cost. It incorporates a number of completely new developments which include: (1) hydraulically driven blade that instantly and automatically varies torque with changes in cutting conditions; (2) clockwise blade rotation to reduce tooth shock when entering the work-piece, thereby increasing blade life and reducing tool cost; (3) positive cutting pressure maintained at all times at a selected constant rate; (4) convenient 36-inch machine height which reduces operator fatigue by eliminating bending and stooping; and (5) large 14- by 24-inch rectangular capacity.

Other features include: dual movable vise jaws; adjustable blade tension, vise jaws, and cutting pressure; grooved blade wheels for different blade widths; double opposed rotary blade-cleaning brushes; a center cutting position; and a Timkenized-bearing pivot bar.

To permit quick adjustment of blade tension, frame feed, and blade speed, all controls are grouped at a central control console. The console is stationed at a comfortable working height so that the operator is kept safely away from the moving frame and blade of the band saw.

Circle Item 594 on postcard, page 191

Hydraulically driven band saw announced by Machine Tool Division of Kalamazoo Tank & Silo Co.



Davis boring head with radial feed

Boring Heads for Small-Diameter Work

Three continuous-feed facing heads for small-diameter boring, facing, turning, counterboring, back-facing, grooving, and chamfering operations featuring uninterrupted radial feed and extreme accuracy are being manufactured by the Davis Boring Tool Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Designed for use with all types of rotating-spindle machines, these facing heads cover a range of diameters from 7/16 inch (with a pencil boring tool) to a recommended maximum of 25 inches. Cutting diameter is controlled by the operator or by adjustable feed stops which may be pre-set accurately to required diameters. Radial feed is adjustable to 0.0001 inch or finer.

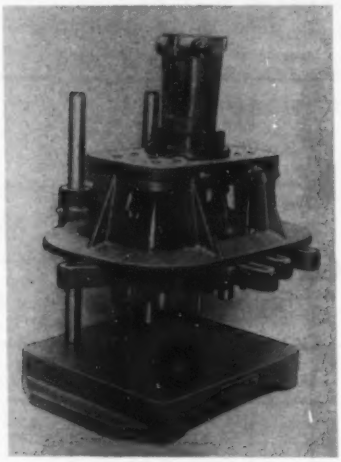
These compact, rigid tools have bodies 4, 6, and 10 inches in diameter. They are available with standard or special shanks for spindle mounting or with flange adapters for sleeve mounting. Other design features include: an adjustable safety clutch which releases under overload; a clamping screw for fixed-slide operations; and a manually operated rapid traverse for the slide.

The feed rate of the 4-inch head is 0.0055 ipr (inch per revolution) with total slide travel of 1 1/4 inches. Maximum recommended cutting diameter is 10 inches.

The 6-inch head feed rate is 0.005 ipr, with a total slide travel of 2 inches. The tool-bar diameter is 1 1/2 inches and the maximum cutting diameter, 18 inches.

The 10-inch head is offered with a standard feed rate of 0.0074 inch and optional feed rates of 0.0055, 0.0089, and 0.0148 ipr. Total slide travel is 4 inches.

Circle Item 595 on postcard, page 191



Universal drilling and tapping head

"Knuckle-Head" Drilling and Tapping Head

The Ettco Tool & Machine Co., Brooklyn, N.Y., has added a Model 1100 "Knuckle-Head" to its line of universal ball-joint adjustable-spindle drilling and tapping heads. This head can be operated with from two to eleven spindles. It converts any single-spindle drill press into a high-production, multiple-spindle machine. Easily interchangeable Ettco faceplates adapt this head for either drilling or tapping up to 5/16-inch holes in steel. The spindles can be set to any hole pattern within a working area of 6 by 12 inches.

These heads are ideal for short- or medium-run work and can be operated at top speed in either direction without vibration regardless of spindle location. One-shot lubrication insures smooth running and long wear. Each head is unconditionally guaranteed for workmanship, materials, and performance. Guide bushings are provided in the gear case for extra rigidity and alignment when guide rods are required. Aluminum templates, jig-bored to requirements, can be supplied instead of spindle-locating arms when a fixed-spindle set-up is desired.

Circle Item 596 on postcard, page 191

Wales-Strippit Fabricator

Wales-Strippit, Inc., a unit of Houdaille Industries, Inc., Akron, N. Y., is introducing a deep-throat model of its Strippit Fabricator at the National Metal Exposition. Designated the "Super 30 Fabricator," this machine is a single-station, high-speed punch press with a throat depth of 30 inches. For straight-line punching, it will handle a 30-inch-wide work-piece of any length, utilizing the Strippit multiple-stop gaging system. For production punching with the Strippit Duplicator, its maximum work size is 25 by 30 inches.

Hole-punching capacity ranges from a 3 1/2-inch hole in 16-gage mild steel to a 1/2-inch hole in 1/4-inch mild steel with a tolerance of plus or minus 0.005 inch. It will handle 90-degree corner notching work up to 5 by 5 inches in 16-gage mild steel as well as rectangular, radii, V- and special-shaped edge notches. The machine will do straight-line nibbling and contour shearing at 165 strokes per minute with a capacity of 1/8 inch in mild steel. A single switch permits instant change-over from single-stroke punching to nibbling. The fabricator features the Strippit quick-change punch and die system.

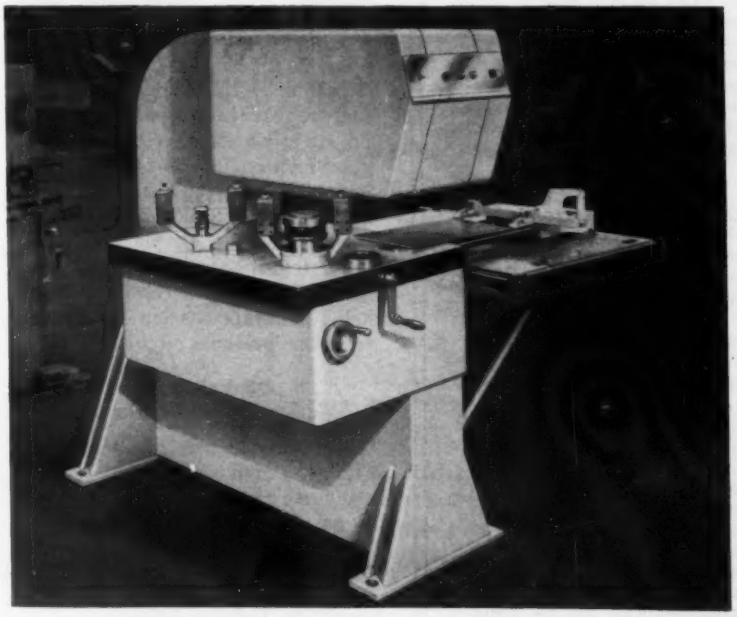
On the adjustable table of the machine illustrated are the two tool-holders and corresponding dies. At the left is shown the holder for punching holes up to 1 1/4 inches in diameter and on the right, the holder for punching holes larger than 1 1/4 inches and up to and including 3 1/2 inches in diameter.

Among other outstanding features of the machine is the new electric head that controls the operation of the ram.

In addition to the electric head, the fabricator features an adjustable table, which permits the use of pedestal dies to enable the operator to punch holes in angles, shapes, and formed parts. An important accessory for the fabricator is the Strippit Duplicator which can be built in as an integral part of the machine. The Duplicator works on the pantograph principle and utilizes a template for production-run punching of sheet-metal parts or printed circuit boards. With the addition of another accessory, called the Dupl-O-Scope, the Duplicator can also be used to make templates from drawings, layouts, or sample parts.

Circle Item 597 on postcard, page 191

(This section continued on page 197)



"Super 30 Fabricator" introduced by Wales-Strippit, Inc.

R B&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By John S. Davey

The choice between a cap screw and socket head screw

If you have the choice, make it a socket screw when you have a space problem, but choose the cap screw for more holding power per dollar.

No question that you should apply socket screws in counterbored holes; and that you can clear tight spaces. What you can't do is utilize the full strength of the alloy needed for the socket head. And remember, strength of a connection depends on how you preload the fasteners, and not on the strength of the fastener material alone.

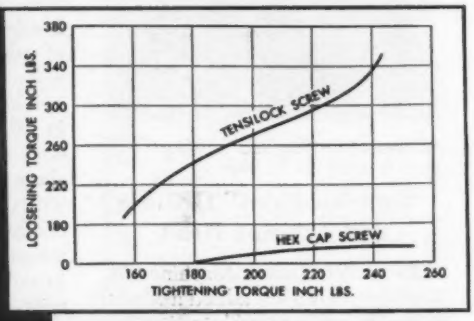
THE HANDICAPS OF ONE

Internal wrenching rarely develops as much torque as needed for proper preloading. And if high torque is developed, the smaller bearing area of the socket head tends to crush the surface on which it bears rather than increase tension or preload.

THE ADVANTAGES OF THE OTHER

If you design to take advantage of heat treated cap screws of SAE grade 5 quality, you'll get a stronger connection at lower cost. These standard fasteners have ample bearing and wrenching surfaces, can be torqued right up to yield strength. They also cost less than the alloy fasteners.

New TENSILOCK* Screws seat tighter, lock tighter



Graph shows example of on-torque and off-torque relationship. It takes more torque to loosen than to tighten.

RB&W's new TENSILOCK screws, the toothed fasteners with high tensile locking, are identified by six radial dashes on flange.

Head has integral washer face with teeth that lock fastener to surface. Circular groove allows flange to flex and seat to bear solidly on surface.

RB&W's TENSILOCK fasteners feature ratchet-like teeth formed at an angle which cuts driving effort yet which enables the teeth to bite in firmly and give an improved grip against back-off.

In addition, a circular groove in the integral "washer" permits the flange to flex upon tightening, and helps maintain tension in the fastener and pressure on the teeth.

IMPROVED TENSION TO TORQUE RATIO

With reduced friction under the head, the new tooth design has enabled more of the wrenching torque to be used to develop tension and less to overcome friction. Since the flange flexes, it allows the screw to bear solidly on its seat. All of the high strength capabilities of these heat-treated one-piece fasteners can now be attained for a stronger assembly.

MORE LOCKING POWER

Tensilock screws need up to 40% more off-torque than on-torque. Combining this feature with the higher residual tension, and the diaphragm action of the integral washer face, these fasteners give superior locking and holding power for permanently tight, strong joints . . . even under severe vibration and cyclic temperature changes.

Now available in limited range of screw types (not in flat head), and in various nut sizes. For details, write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, New York.

* Trade Mark Pat. applied for.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa., Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

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NEW CATALOGUES

MOTOR DRIVES—Reeves Pulley Division, Reliance Electric & Engineering Co., Cleveland, Ohio. 96-page catalogue M-592, explaining the wide assortment of styles, modifications, and accessories available in the complete line of the company's mechanical variable-speed "Motodrives." It includes construction features, specifications, and speed and rating tables. Copies are available free by writing on your company letterhead to Reeves Pulley Division, Reliance Electric & Engineering Co., 1015 N. Wilson St., Columbus, Ind.

WELDING WIRES—Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. 84-page revised edition (Form ADC 873A) of the company's Aircomatic "Welding Wire Pocket Guide," including the latest information on Airco's complete line of gas-shielded metal-arc welding wires, including data on the improved A675 steel wire, and the new A666 steel and A556 aluminum. It contains technical information such as chemical composition, mechanical properties, and operating procedures, as well as wire diameters and packaging data. **501**

CHECK VALVES—Parker-Hannifin Corporation, Parker Hydraulics Division, Cleveland, Ohio. Catalogue sheets 1517-A12 and 1517-AB, describing two new models of steel hydraulic check valves. Both are the spring-loaded cone type and for in-line installation. Model VCL-F has "Triple-lok" flare ends for connecting JIC 37-degree flared tubing. Size range is from 3/8-inch through 1 1/4-inch outside-diameter tubing. Model VCL-P has female pipe-thread ports ranging from 1/4-inch through 1 1/4-inch I.P. sizes. **502**

CUTTING TOOLS — Disston Division, H. K. Porter Co., Inc., Philadelphia, Pa. Four catalogue sections featuring industrial saws and cutting tools. Heading the list of two-color catalogues is the 32-page solid and inserted-tooth circular-saw section. It includes a section on proper selection of a saw, proper selection of saw gage and number of teeth, and lists the most popular tooth styles for various types of saws. The catalogue sections are available singly or in combination at no charge. **503**

FOUNDRY SAFETY—Gray Iron Founders' Society, Inc., Cleveland, Ohio. Booklet entitled "Starting A Safety Program." The 10-page booklet is intended to encourage foundry managers to "sell" the need for improved foundry safety in their own organization, and then to show them how to "get going" on a sound and effective program. The booklet will be a running mate to "How You Can Work Safely," another manual issued by the society for use by shop employes. **504**

SPECIALTY STEELS — Carpenter Steel Co., Reading, Pa. 40-page bulletin, a guide for buyers of specialty steels, containing detailed information on tool and die steels; stainless steels; high-temperature alloys; electronic, magnetic, and electrical alloys; special-purpose alloy steels; tubing and pipe; and fine-wire specialties. Included in the booklet is a tool-steel selector chart which provides a system of matching tool steels without resorting to "cut-and-try" methods. **505**

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SUPERALLOYS—Kelsey-Hayes Co., Metals Div., New Hartford, N. Y. Two bulletins, covering performance data on vacuum induction-melted Udimet 700 and Udimet 41 superalloys. Each bulletin includes: alloy description and chemical composition, physical contents, tables and charts on mechanical properties, isostress curves, and information on heat-treatment and finishing. **506**

MANUAL PRESS CONTROLS — Micro Switch, Freeport, Ill. Catalogue 65b, revised and expanded to give more application data and helpful ordering information. It tells how Micro Switch "Trip Control" can be easily applied to manually operated stamping machines, air presses, riveters, press brakes, shears, welders, paper cutters, etc., to make them safer and more productive. **507**

MOISTURE DAMAGE AND CORROSION PREVENTION—Corrosion Reaction Consultants, Philadelphia, Pa. Folder presenting an inhibitor that displaces and seals out water and moisture, protects metal surfaces against corrosion, and lubricates. Called CRC 2-26, this liquid formula has been especially developed for manufacturing and maintenance use in the electrical- and electronic-equipment fields. **508**

BEARINGS—Kaydon Engineering Corporation, Muskegon, Mich. Bulletin S-107, presenting the first extremely thin section bearing line to be available "off-the-shelf." Designated as the Kaydon "Reali-Slim" "CP" bearings, the new line will include 90 sizes with from 4- to 12-inch bores at prices reduced up to 76 per cent below usual custom-production prices for similar bearings. . . **509**

O.B.I. PRESSES—Niagara Machine & Tool Works, Buffalo, N. Y. 28-page bulletin 58N, presenting a redesigned line of Series A inclinable presses, featuring an exclusive multiple-point mechanical sleeve clutch. Performance test data on twenty-eight machines single-stroked 707,140,000 times are given as fact-and-figure proof of the design's economical performance. **510**

DRILL HEADS — Cleveland Pneumatic Industries, Industrial Sales Division, Skokie, Ill. Five new catalogue sheets, describing the complete series of Cleveland multiple-spindle pneumatic Johnson drill heads, illustrating in complete detail design advantages, construction features, and dimensions, as well as listing recommended spindle sizes for various drilling jobs. **511**

SHEARS—Cleveland Crane & Engineering Co., Wickliffe, Ohio. Catalogue No. 2030-A, describing the line of Steelweld hydraulic shears with pivoted-blade action. The booklet provides construction details and specifications on the shears, which are available in all sizes for cutting metal in lengths to 30 feet and in all thicknesses to 2 inches. **512**

DRAFTING TABLES—Stacor Equipment Co., Newark, N. J. Bulletin No. SU-620m featuring a new kind of drafting table made in France and distributed in the United States and its possessions exclusively by Stacor. Its design features precision-engineered floating-board action so that it literally floats into any desired position and holds securely without wobbling. **513**

CONTOUR MACHINE—DoALL Co., Des Plaines, Ill. Catalogue describing heavy-duty contour machines, the heaviest and most rugged of the three lines of stationary table band machines recently redesigned in order to incorporate many new features. The catalogue describes these features and illustrates their application in typical shop work. **514**

HEAT-EXCHANGER EQUIPMENT—Babcock & Wilcox Co., Tubular Products Division, Beaver Falls, Pa. Bulletin TB-421, describing all the attributes of B & W's new line of "Lectrosonic" heat-exchanger tubes, demonstrating how quality-controlled manufacturing procedures provide for good fit in tube sheets, ease of fabrication, and optimum fluid flow. **515**

"STOCK STRAIGHTNER"—Dickerman Mfg. Co., Springfield, Mass. Folder describing a new "stock straightner," explaining its essential features, such as portability from one press to another, deburring of shear-slit stock, variable speed for operating at most suitable speed of automatic press, etc. **516**

UNIVERSAL GRINDING MACHINE—Heald Machine Co., Worcester, Mass. Bulletin 2-273A-1, describing design features, applications, specifications, and accessories of the company Model 273A universal internal-grinding machine, a high-precision grinder for internal, external, and rotary surface grinding. **517**

PRESS BRAKES—Verson Allsteel Press Co., Chicago, Ill. Catalogue describing the company's line of hydraulic press brakes. It gives specifications on models ranging in capacity from 150 to 1800 tons plus information on design details and photographs of typical models. **518**

OPTICAL EQUIPMENT—Keuffel & Esser Co., Hoboken, N. J. 25-page illustrated catalogue entitled "Optical Tooling and Industrial Alignment Equipment," describing the complete K & E line of equipment for production tooling, machine alignment, quality control and inspection—the largest line available. **519**

MACHINE REPAIR—Gahr Machine Rebuilding Co., Cleveland, Ohio. Brochure entitled "Repair, Rebuild, or Replace?" giving information on how to draw the line between repairing and rebuilding, telling when you can get by with the one and when you need the other. . . **520**

SPEED REDUCERS—De Laval Steam Turbine Co., Trenton, N. J. 32-page cata-

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logue featuring single-reduction worm-gear speed reducers with a high-load capacity thread form and utilizing high-strength materials. 521

AIR STAKER—Cramer Controls Corporation, Centerbrook, Conn. Brochure describing an arbor press, which performs pressing or staking operations independently, or in combination. 522

PRECISION BALLS—Industrial Tectonics, Inc., Ann Arbor, Mich. Bulletin BU-1, presenting the company's line of precision balls. It discusses raw ball materials, methods of manufacture, precision, finish, sizes, and quantities. 523

GRINDING AND POLISHING—Murray-Way Corporation, Birmingham, Mich. Brochure (Form 59-1), describing the company's "Micro-Polish Units" for grinding and polishing coils, blanks, and sheets in all materials. 524

PRESSES—K. R. Wilson, Inc., Arcade, N. Y. Bulletin 5-B, containing details of the recently modernized KRW straight-side, single-action, hydraulic press line, which has been expanded to include a range of 25 through 1000 tons. . . .525

OVENS—Despatch Oven Co., Minneapolis, Minn. Reference catalogue serving the needs of procurement personnel in the metal, electrical, chemical, and other industries. It gives basic information about laboratory ovens, pilot plant ovens, small-batch type production ovens, and furnaces. 526

PRESS BRAKES—Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin No. 91, describing the company's line of forty-four models of hydraulic press brakes. Featured is a selection chart, showing at a glance the essential differences between mechanical and hydraulic brakes in use, tonnage, stroke, speed, accuracy and ram adjustment. 527

VALVES—Valcor Engineering Corporation, Kenilworth, N. J. Booklet entitled "How To Specify Solenoid Valves," showing how to eliminate the waste of time and money caused by "insufficient and incomplete specification of what the valve must do with what media, under what conditions, and for how long." 528

GRINDER—Landis Tool Co., Waynesboro, Pa. Bulletin RP-59, describing and illustrating the company's new "R Plunge" production grinder, a single-purpose unit for use in plants where high production is required to extremely close tolerances. 529

CAST-IRON SECTIONS — Ex-Cell-O Corporation, Detroit, Mich. Bulletin 355913, describing how micron sections are machined square and parallel on outside surfaces, saving machining time and eliminating welding. They are available in eight shapes and a practical range of sizes. 530

ELECTRONIC GAGING—Radio Corporation of America, Industrial and Automation Division, Detroit, Mich. Brochure presenting electronic-gaging systems, giving complete description of such systems and of each of the modules comprising them. Typical applications are shown. 531

ABRASIVE SAWS — Wallace Supplies Mfg. Co., Chicago, Ill. Catalogue describing modular "Cut-Machining" units in four sizes of cutoff wheels: 16-, 18-, 20-inch, as well as, for the first time, 26-inch diameters. 532

SAFETY SWITCH—American Electric Switch Division, Clark Controller Co., Cleveland, Ohio. Bulletin PL 250-ND, describing the company's switch line, and featuring Type "ND" safety switches designed for normal-duty industrial and commercial use. 533

TOOL STEEL—Uddeholm Co. of America, New York City. Booklet featuring their high-carbon, high-chrome, air- and oil-hardening tool steel, "Tri-Tung," a steel which is capable of great hardness, exceptionally good wear resistance, and manifests minimum distortion with air-hardening. 534

DIE CUSHIONS—Verson Allsteel Press Co., Chicago, Ill. Catalogue describing the company's line of die cushions—pneumatic, hydropneumatic, and hydraulic types. Size and capacity data are given as well as information on typical die-cushion arrangements. 535

HYDRAULIC EQUIPMENT—Groban Supply Co., Chicago, Ill. 60-page catalogue presenting hundreds of newly manufactured and surplus industrial items. A special section is devoted exclusively to hydraulic equipment. Other sections deal with the diesel, automotive fields, etc. 536

CUTTING TOOLS—Pratt & Whitney Co., Inc., West Hartford, Conn. Circular presenting splined milling cutters and arbors which accelerate stock removal rate, increase cutter life, and permit machining of high-strength alloys at conventional speeds and feeds. 537

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MOTORS—Marathon Electric Mfg. Corporation, Wausau, Wis. Bulletin SB-182, describing a new line of direct-current motors and generators which feature interchangeability, rating for rating, with corresponding NEMA alternating-current induction motors. **538**

PROTECTIVE COATINGS — Bischoff Chemical Corporation, Hicksville, N. Y. Bulletin on "Thermo-Cote" strippable plastic coatings. It shows how easily tools and small metal parts are protected with a tough, transparent coating by dipping them in Thermo-Cote melt. **539**

BORING-BARS AND HOLDERS—Globe Tools, Los Angeles, Calif. Catalogue sheet describing a complete line of boring-bar holders and calibrated boring-bars, consisting of six sizes of holders and twelve sizes of bars, to fit lathes of 8- to 36-inch swing. It gives complete specifications and use features. **540**

MULTIPLE-SPINDLE MACHINES—Sundstrand Machine Tool, Division of Sundstrand Corporation, Belvidere, Ill. Brochure describing a variety of multiple-spindle precision boring, drilling, and tapping machines. Typical performance data and specifications are given. ..**541**

SPEED REDUCERS—Link-Belt Co., Chicago, Ill. Booklet 2751, presenting information on a complete line of helical-gear speed reducers. This book consolidates all of the company's expanded line of "In-Line" speed reducers in a single catalogue. **542**

BORING MILLS—Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. Illustrated data sheet describing features and applications of the company's "Tele-Vernier" optical measuring system for horizontal boring, milling, and drilling machines. **543**

BARREL FINISHING—Carborundum Co., Niagara Falls, N. Y. 36-page booklet detailing a seven-point system for scientifically controlled barrel finishing, entitled "CARBOtrol 7." **544**

JIG AND FIXTURE COMPONENTS—Northwestern Tools, Inc., Dayton, Ohio. Catalogue No. 29, describing components for jigs and fixtures such as knobs, clamps, shoes, etc. **545**

SOCKET-SCREW STANDARDS—Standard Pressed Steel Co., Jenkintown, Pa. Bulletin (Form 2338) describing the complete line of "Unbrako" standard socket-screw products. **546**

POSITIONING SYSTEMS — Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. Bulletin 759, describing automatic positioning systems for the company's horizontal boring, drilling, and milling machines. **547**

ALLOY—Titanium Metals Corporation of America, New York City. Bulletin discussing heat-treatable titanium alloy, Ti-4A1-3Mo-1V, developed to meet the requirements of high-speed aircraft. **548**

FACE SHIELDS—American Optical Co., Safety Products Division, Southbridge, Mass. Brochure presenting a variety of face shields with their many applications, as well as fluids for keeping them clean. **549**

SPECIAL STEEL — United States Steel Corporation, Pittsburgh, Pa. Booklet entitled "How to Weld U. S. Steel's 'T-1' Steel," including "heat input calculator" for use in welding this steel. **550**

For Advertisements—Circle Numbers

COVERS: FRONT — INSIDE BACK — INSIDE FRONT — BACK

For New Equipment, Catalogues—Circle Item Numbers

11/59

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11/59

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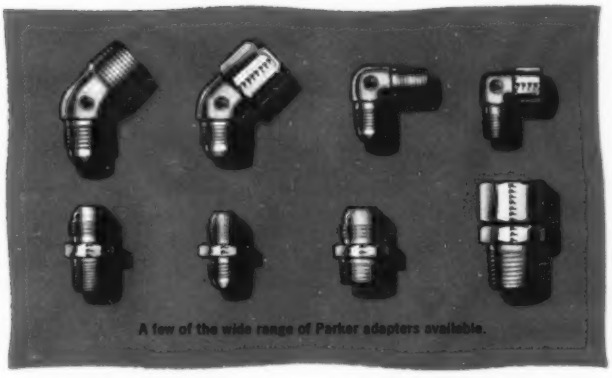
PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

Now from Parker

BOTH permanent-end and re-usable hose assemblies

Parker "Krimp-lok" hose assemblies — supplied in a wide variety of fittings-and-hose combinations for any type of service and fluid.


A few of the wide range of Parker adapters available.

You may require permanent-end hose assemblies for your production AND re-usable fittings with coils of hose for quick, trouble-proof replacements in the field. With the addition of Parker's new "Krimp-lok" fittings, permanent-end assemblies are now available from Parker. They use the same Parker hoses that enjoy a wide acceptance when used with Parker *no-skive* "Hoze-lok" fittings in the replacement field.

A full range of Parker adapters is also available.

Ask your Parker Hose Distributor, listed in the Yellow Pages, for engineering advice and literature on "Hoze-lok" re-usable fittings, also Parker hose and adapters. Write us in Cleveland regarding your requirements for Parker "Krimp-lok" Hose Assemblies.

Parker

FITTINGS AND HOSE DIVISION

17325 Euclid Avenue

Cleveland 12, Ohio

Parker "Hoze-lok" no-skive hose fittings and Parker hose, the ideal combination for short run production and quick, reliable field replacement.

A DIVISION OF PARKER-HANNIFIN CORPORATION

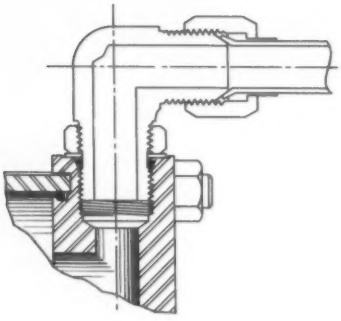
Bronze cartridge gland with "LIPSEAL"® and "WIPERSEAL" can be easily replaced without dismantling cylinder.

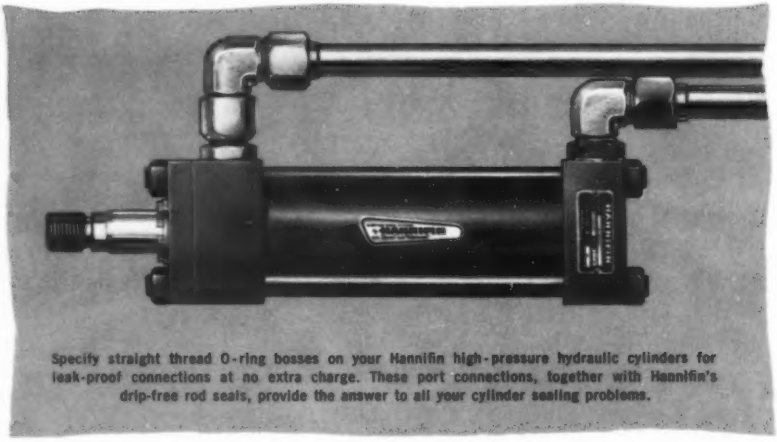
Drip-free rods, leak-proof ports...

get both with

HANNIFIN

hydraulic cylinders





Specify straight thread O-ring bosses on your Hannifin high-pressure hydraulic cylinders for leak-proof connections at no extra charge. These port connections, together with Hannifin's drip-free rod seals, provide the answer to all your cylinder sealing problems.

Select either "Step-Seal" piston rings (standard) for most applications or exclusive "LIPSEALS" where zero "clearance flow" is required.

For absolutely leak-proof connections under all operating and installation conditions, get Hannifin hydraulic cylinders with S.A.E. straight-thread ports. There's no extra cost. And because a straight-thread fitting is tightened *after* alignment, not aligned by "backing off," sealing is positive even when the cylinder must be mounted in tight quarters.

Straight-thread ports, plus the removable-replaceable cartridge gland that seals Hannifin cylinder rods drip-free, keep machines, floor and product free of hydraulic oil.

Other Hannifin cylinder features include ground and polished rods induction-hardened to an extra-deep case, then hard-chrome plated and polished again; cylinder walls that are "Tru-Bored" straight and perfectly round *before* being honed . . . PLUS 48-hour shipment in emergencies on standard Hannifin cylinders.

Your nearest Hannifin sales office or representative is listed in the A-Z volume of Thomas' Register. Call us in when cylinders figure in your designs. Or, for cylinder literature, write:

HANNIFIN COMPANY

515 South Wolf Road • Des Plaines, Illinois

"Pilot-Arc" Starting for Heliarc Spot Welding

"Pilot-Arc" starting, a development of Linde Company, division of Union Carbide Corporation, New York City, now makes it possible to obtain positive arc starting for Heliarc (inert-gas tungsten-arc) spot welding or cutting in a split second whenever required. This is of particular importance in mechanized installations where torches must be fired according to a predetermined schedule. Pilot-Arc starting is said to eliminate all high-frequency interference problems and to avoid the contamination problems of retract starting.

The Pilot-Arc system shown in the diagram acts much as the pilot light in a gas stove. It keeps a ball of incandescent gas within the cup so that the arc is always ready to fire as soon as potential is applied between torch and work-piece. The Pilot-Arc current is adjusted to about 5 amperes and is maintained between electrode and water-cooled nozzle. A small quantity of shielding gas flows continuously and protects the electrode.

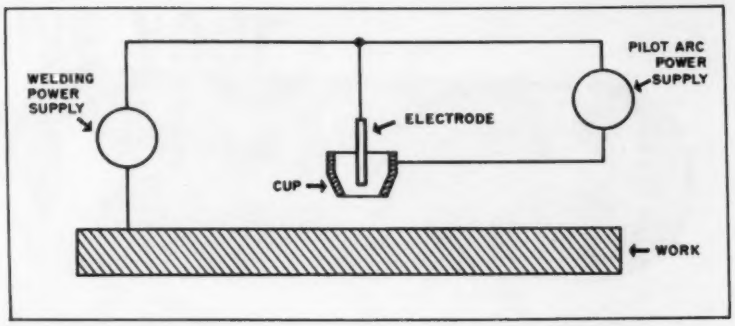


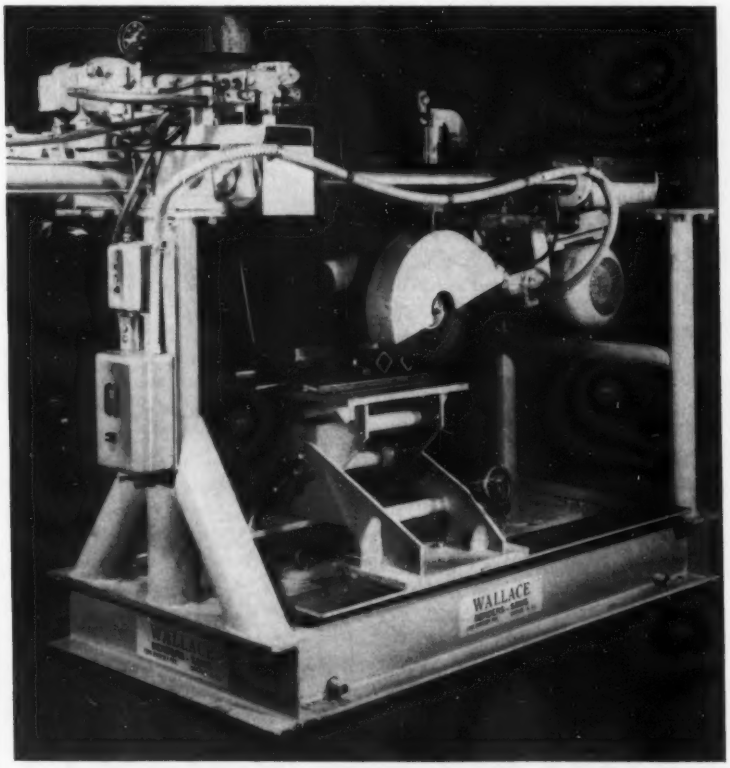
Diagram showing connection for power supply of "Pilot-Arc" which is maintained between electrode and torch nozzle

When the torch is brought into welding position against the work, and the trigger pulled, the Pilot-Arc provides a path for the main welding current which instantaneously flashes across to the work and makes the spot weld. With this equipment the operator lights his torch at the start of the work shift, using a tungsten rod to make contact between the tungsten electrode and the nozzle. The torch stays lit throughout the work day. The Pilot-Arc then maintains the electrode in an incandescent state so that the torch is always hot and ready to fire.

Circle Item 598 on postcard, page 191

Wallace Traversing "See-Saw" Cutoff Machine

An oscillating type abrasive cutoff machine employing the traversing "see-saw" principle has been announced by the Wallace Supplies Mfg. Co., Chicago, Ill. This machine is available in three sizes having 20-, 26-, and 34-inch wheels. The 20-inch wheel unit can cut shapes which equal a 24- by 6-inch I-beam, and it has a rating of 15 hp. It has a stroke of 24 inches. The 26-inch unit can cut shapes which equal a 30- by 8-inch I-beam and is rated at 20 hp. Both of these machines cut dry. The 34-inch unit can cut shapes (wet only) which equal a 36- by 12-inch I-beam and is rated at 40 hp. Plates and other metal sections can be easily cut on these machines.



Abrasive cutoff machine announced by the Wallace Supplies Mfg. Co.

Other than standard stroke lengths can be supplied. Very fine finish and high-speed cutting are characteristics claimed for these units. Cut surfaces may, in some cases, have less than a 50-micro-inch finish. Standard 60-pound per foot channel sections have been cut in sixty seconds.

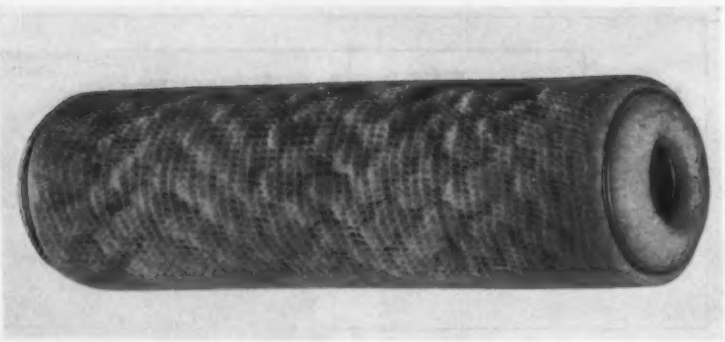
These rugged units operate on the "see-saw" principle that allows the wheel to "sense" its own best cutting rate in order to prevent overloading. Traverse feeds are vernier controlled. An on-off thumb switch facilitates control of the traverse movements.

Circle Item 599 on postcard, page 191

(This section continued on page 198)

For more data on Hannifin cylinders, circle 195 on inquiry card

For more data on Parker fittings, circle 196 on inquiry card



AFCO "Feutron" filter cartridge

Precision Liquid Filter Cartridge

The American Felt Co., Glenville, Conn., has introduced a scientifically designed, precision filter cartridge that is adaptable to a wide range of applications in the filtration field. The synthetic fiber felt used in this filter carries the trademark "Feutron." Extensive tests are said to have proved this new product to be an ideal filtering material for the precise needs of industry.

Although the filter cartridge has found its first commercial use in the paint industry, it is said to offer unlimited application in many other fields where exacting clarity requirements are standard or are contemplated.

At present, the AFCO Feutron filter cartridge is being made in a single size to fit either the 9 3/4- by 2 1/2-inch or the 10- by 2 3/4-inch filters generally considered as standard in this field.

Circle Item 600 on postcard, page 191

Roller Bearings with New Cage Design

A series of roller bearings with channel-shaped outer rings has been introduced by the Torrington Co., Torrington, Conn. A patented cage design is said to permit application of these bearings at speeds higher than those attainable with full complement types. Longer and larger rollers are used in these standard inch-size, cage type roller bearings (shown in Fig. 1) to obtain greater capacities. Made in bore sizes ranging from 3/4 inch to 4 inches, and designated series HJ, the bearings may be applied directly to hardened and ground shafts or used with inner rings which are also available. Boundary dimensions conform to AFBMA series NAA and NAB standards and the bearings are interchangeable with needle bearings made to these standards.

The distinctive one-piece cage design separates roller-guiding and roller-retaining functions by employing a cage bar depressed within the roller pitch circle as shown by the diagrams, Fig. 2. Roller guidance takes place at the ends of the rollers, and at the pitch line where guidance is most effectively accomplished with minimum friction. Rollers are retained by the middle portion of the cage bar which is always out of contact with the rollers during operation, preventing needless wiping away of lubricant common with ordinary cylindrical cages. The lubricant circulates freely through the bearing.

Rollers have controlled-contour profiles, the ends being a few hundred-thousandths of an inch less in diameter than the middle. This end-relief design prevents stress concentration at the ends of the rollers and insures uniform load distribution. The new design is said to give extremely long service life.

Circle Item 601 on postcard, page 191

(*This section continued on page 202*)

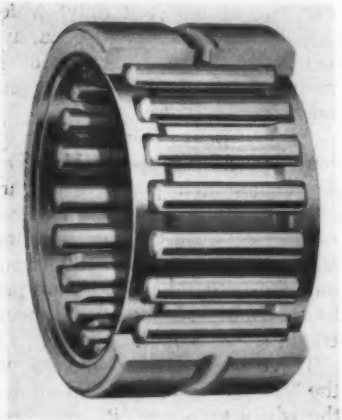


Fig. 1. Torrington roller bearing with newly patented cage design

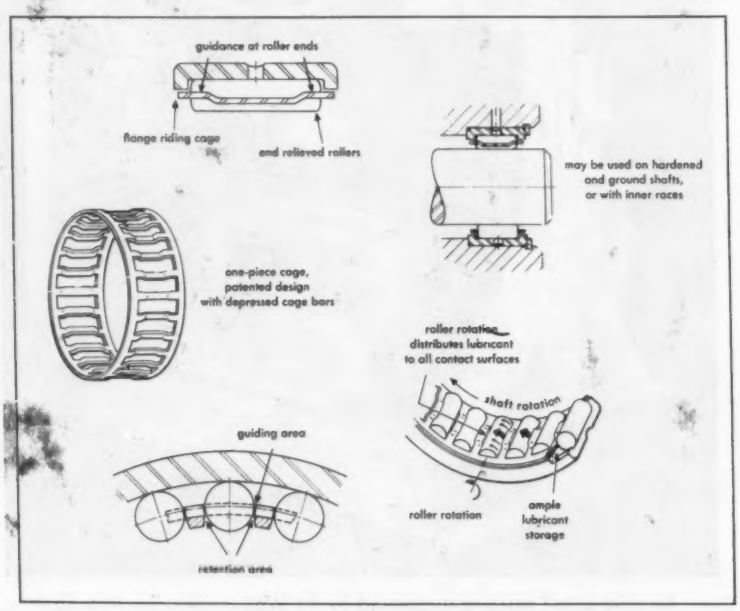
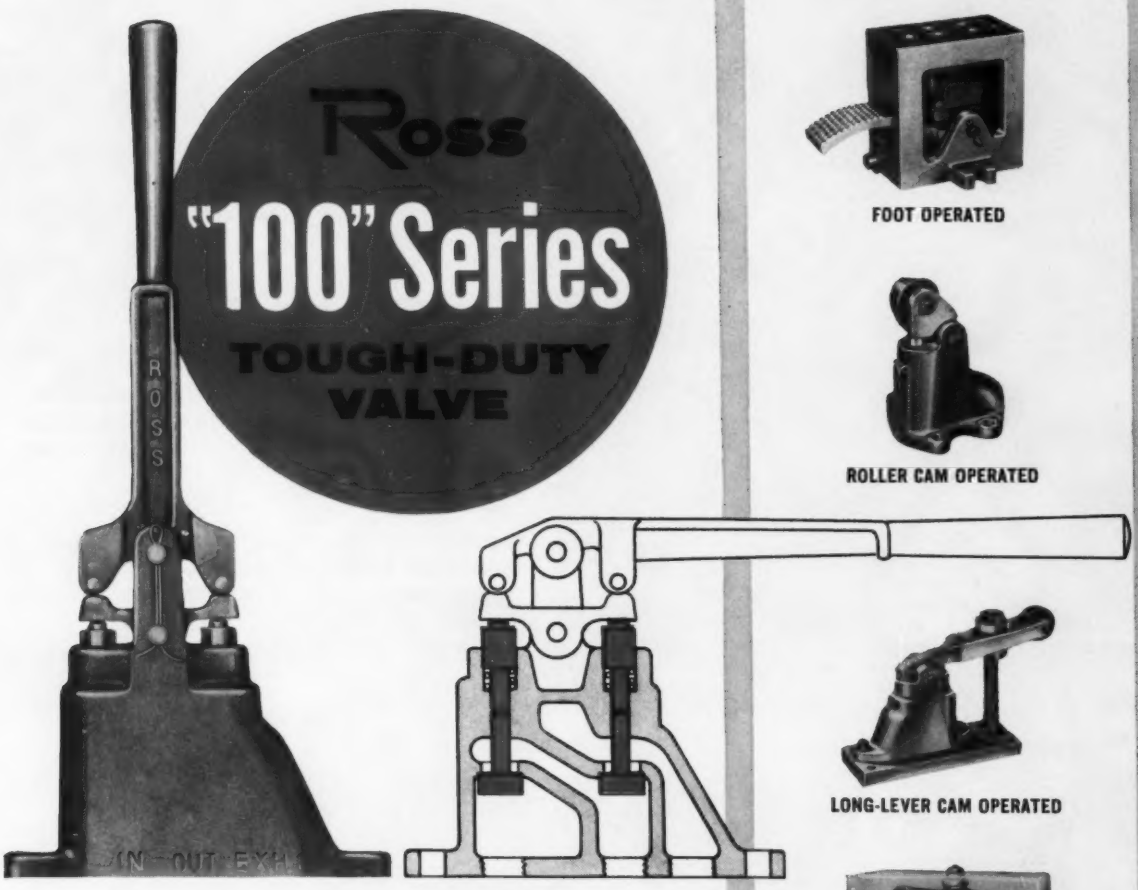

guidance at roller ends
flange riding cage
end relieved rollers
may be used on hardened and ground shafts, or with inner races
one-piece cage, patented design with depressed cage bars
roller rotation distributes lubricant to all contact surfaces
shaft rotation
guiding area
roller rotation
ample lubricant storage
retention area

Fig. 2. (Right) Diagrams showing the design and functioning of the one-piece cage of bearing shown in Fig. 1

Give this valve your *ROUGHEST* jobs!

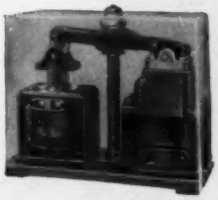


foot, cam, solenoid versions available, too

FOOT OPERATED

ROLLER CAM OPERATED

LONG-LEVER CAM OPERATED



SOLENOID DIRECT OPERATED

Steel mills, foundries, mines, offshore drilling, logging . . . these industries love the Ross "100" Series valve. Here's why: It performs well wherever you need a manually operated valve, but it is really the finest, most dependable valve available for use where the environment is rough and tough. The "100" Series valve will pass most dirt and foreign matter with no trouble and has only a few moving parts. Its poppets travel only a scant fraction of an inch, so it is especially wear resistant. It transmits a "feel" of control to the operator so he may "inch" a cylinder with fine control. Available in locking or non-locking, 3 way or 4 way, closed or cracked-to-exhaust-center models, with handle normally upright or horizontal. Write for further information.

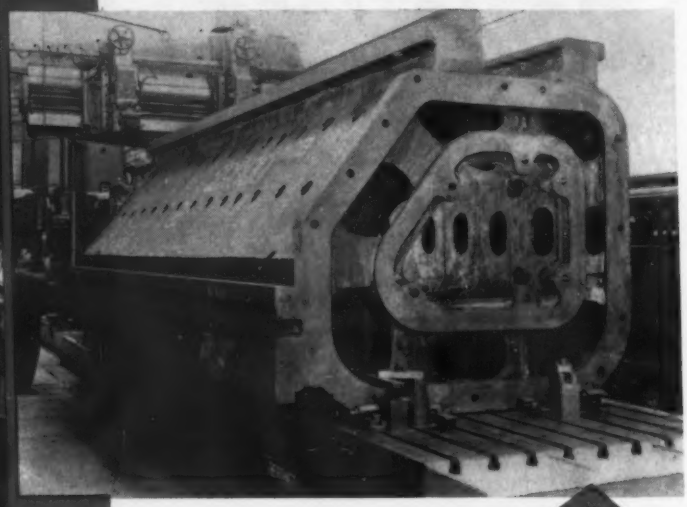
STAY AHEAD
MODERNIZE

ROSS OPERATING VALVE COMPANY
110 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

For more data, circle this page number on inquiry card

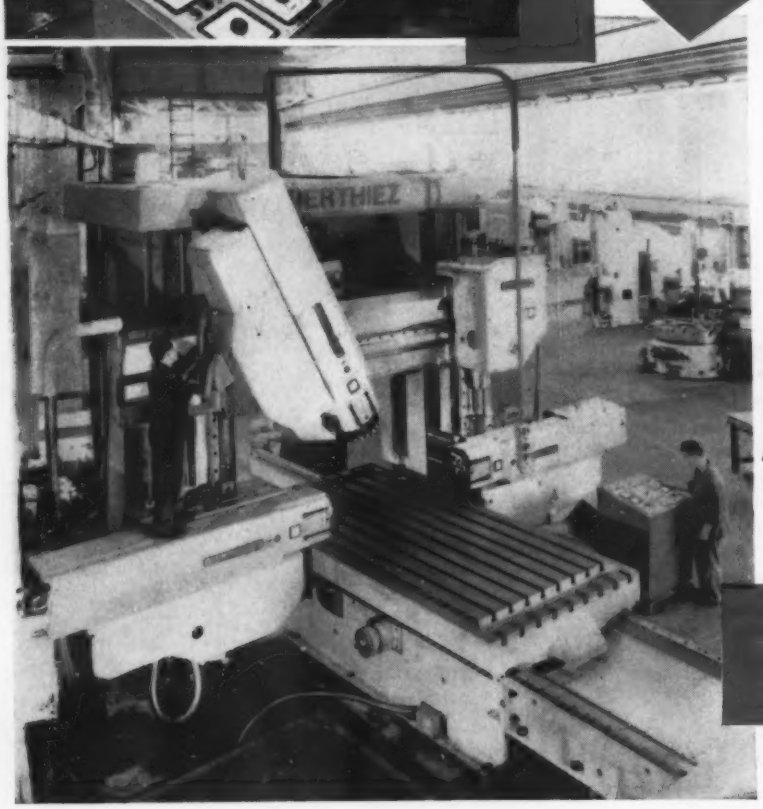
BERTHIEZ

Double Upright Planing
and Milling Machine type R F 2 - 200

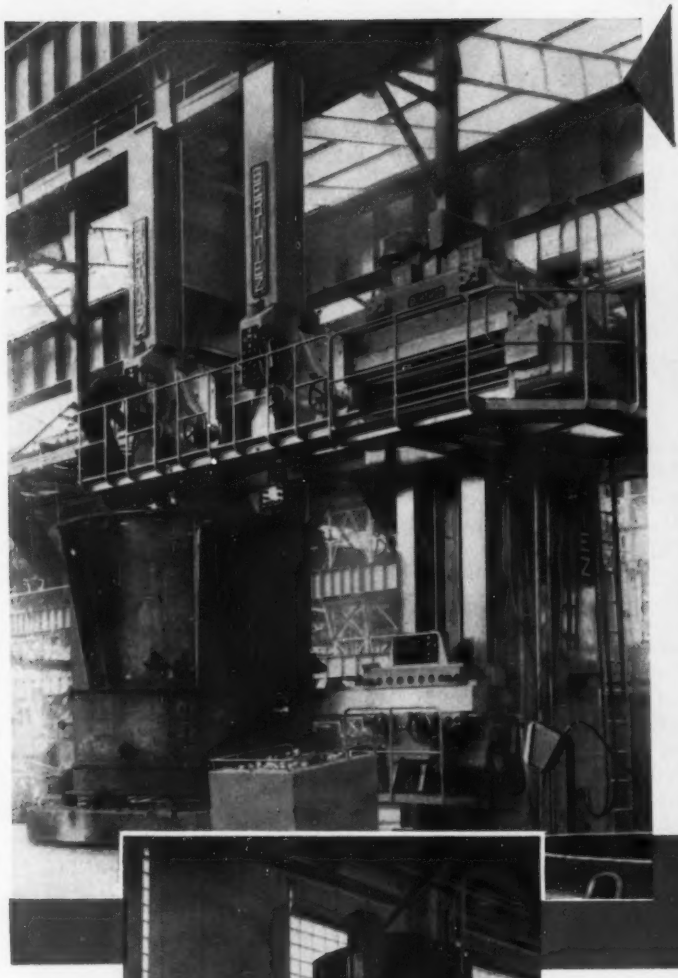


Single Upright Planing Machine
type 9120

Double Upright Plano Milling Machine
type F 2 - 200

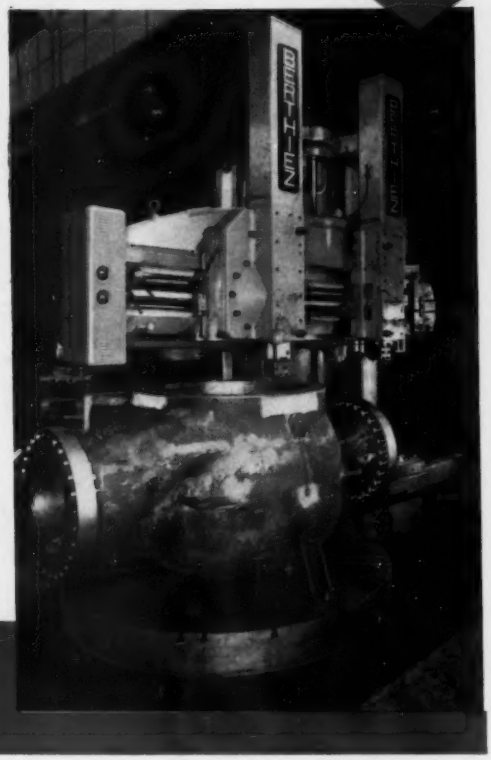


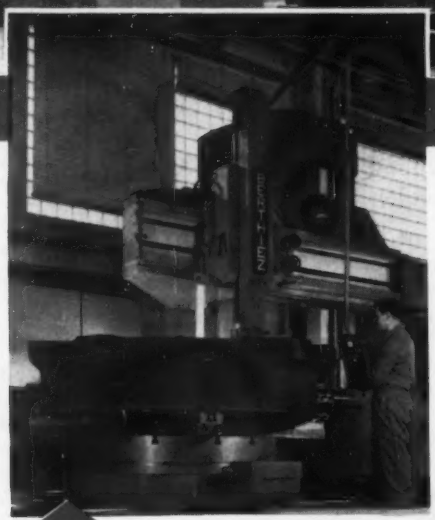
All BERTHIEZ
Planing Machines
plane both ways i. e.
cut coming and going



Vertical Boring and Turning Mill
type 9375

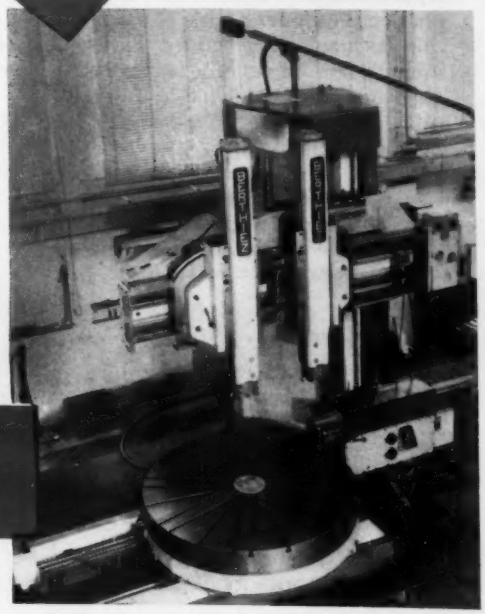
Vertical Boring and Turning Mill
type 9135





Vertical Boring
and Turning Mill type BML 180

Vertical Boring and Turning Mill
type BM 225



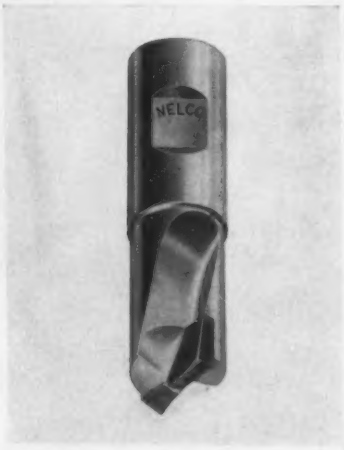
BERTHIEZ

11, RUE MONTALIVET - PARIS 8e - TÉL. ANJ 47-60

Two-Flute Carbide-Tipped End Mill

A Nelco center-cutting, two-flute, carbide-tipped end mill, which is recommended for use in machining all materials, is now available from the Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence, R. I. This Series 600 end mill is a true helix type designed to take plunge cuts and perform peripheral milling operations.

The "radial hook" gives freer shearing action in plunge cuts and



Nelco end mill available from B&S Cutting Tool Division

the short length provides the increased rigidity needed for rugged cutting operations. Greater chip clearance and added flute strength are additional features. This end mill is available in 3/8-, 7/16-, 1/2-, 5/8-, 3/4-, 7/8-, and 1-inch sizes. They will be standard stock which supplements the more than 3300 high-speed steel, carbide, and carbide-tipped cutting tools available from this company.

Circle Item 602 on postcard, page 191

Safety Gloves for Light Welding

The Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City, has recently placed on the market four new types of safety gloves for light welding and general industrial work. Type E-GR is a chrome-tanned, green-cowhide glove with a full gauntlet

Safety gloves placed on market by Air Reduction Sales Co.

for light welding where protection of the hand, wrist, and lower arm is necessary. Type D-SS is a combination light-work, lightweight welding glove. It is also made of chrome-tanned cowhide, with reinforcements at the gauntlet seam, palm seam, and thumb crotch for added strength and protection.

The two other gloves now available are Type AR-1, a high-grade, heat-resistant green-leather welder's mitten designed to allow complete freedom of movement for the thumb and index finger, and Type GR-SS, a flexible, driver-style glove of green chrome-tanned leather for miscellaneous work where light protection is required.

Circle Item 603 on postcard, page 191

Toolmaker's Expanding Transfer Punches

A complete set of transfer punches in three compact tools with a hardwood case 1 inch by 2 3/4 by 5 3/8 inches has been brought out by the Kelly Tool & Mfg. Co., Los Angeles, Calif. With this set, the toolmaker can quickly

Set of toolmaker's transfer punches presented by Kelly Tool & Mfg. Co.

transfer a true center in any hole from 1/4 to 11/16 inch in diameter. The punches can also be used as hole gages. For transferring centers, the punch is used in the same manner as conventional solid transfer punches. It is inserted in a hole within the size range of the punch, and the knurled head is turned until the body has expanded to fit the hole. The punch is then hit with a hammer, after which it is removed by retracting the body. The center pin is retained by a special friction sleeve and may be pulled out from the top end for sharpening.

Circle Item 604 on postcard, page 191

Ear protector announced by the Bausch & Lomb Optical Co.

"Quiet-Ear" Protector Shields Against Noise

A unique ear protector, developed by RCA to meet the need of personnel who work under loud noise conditions, is being distributed exclusively by the Bausch & Lomb Optical Co., Rochester, N. Y. The design of this "Quiet-Ear" marks a new concept in ear protection, since it uses neither bulky absorbing materials nor excessively large sealing shells. Applicable anywhere, where noise becomes a hindrance or a nuisance, this lightweight, sanitary, and inexpensive ear protector is claimed to offer optimum noise protection. It can be effectively used by personnel on carrier flight decks and jet airfields;

(Continued on page 208)

56

S&F GEAR TESTERS CAN'T BE WRONG!

AND THEY NEVER ARE— AT ECLIPSE-PIONEER

Division of Bendix Aviation Corp., Teterboro, N. J.

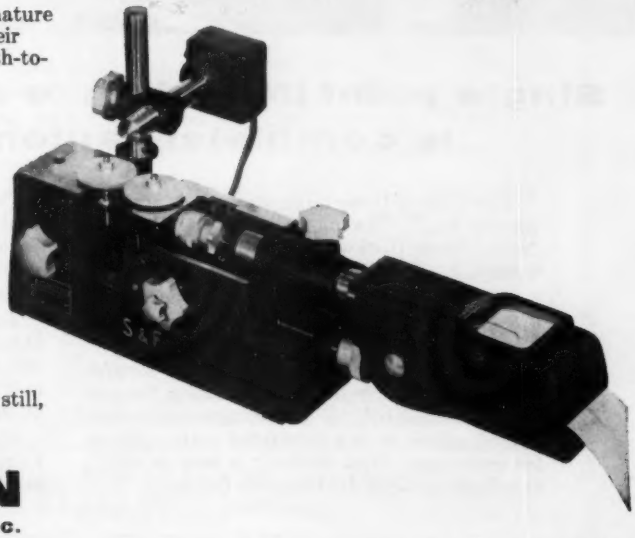
Turning out Precision Class 3 Gears is almost second nature to Eclipse-Pioneer. These are the gears that go into their famous directional gyros for aircraft and missiles. Tooth-to-tooth error, .0002". Total composite error, .0003".

The first S & F Tester bought by Eclipse-Pioneer four years ago told them what they wanted: no other gear checker was so accurate, so easy to use.

So they kept buying them. For floor after floor. Section after section. Year after year. Now, 56 S & F Testers act as guardians of precision all over the plant—assurance that Eclipse-Pioneer gears really hold to the tolerances called for.

Would *you* like to be assured that the gears you make—or buy—are as accurate as they're supposed to be? Check them on an S & F—guaranteed to repeat within .00001"—as 359 plants now do.

Ask us to send you the name of a nearby user. Better still, may we demonstrate the S & F for you?



KO SCALE PRECISION MACHINERY

KURT ORBAN

COMPANY, INC.

42 Exchange Place, Jersey City 2, N. J.

For more data, circle this page number on inquiry card

JONES & LAMSON TURRET LATHES

the man who needs a new machine tool is already paying for it

Single point threading to a finish of 15-20 RMS is completely automatic–and fast

The I. D. of these large cap-nuts is approximately 5¼". The material is High Chrome Nickel Steel, Rockwell C 30–32. The thread is 8 pitch, 5 ½" long, *and tapered .005" per inch.*

It's a tough job to make time on, but a J & L Turret Lathe equipped with an Auto-Threader, does the threading in 5 minutes!

Here's how: The part is faced and a rectifying bore is made; in the same chucking, threading is completed in 16 automatically-controlled passes, with a graduated cutting depth for each pass. *Pitch diameter is held to .002",* and finish is 15–20 RMS on the flanks.

On the old machine, milling the thread alone took 75 minutes. With this new setup, the entire operation — including loading, facing, boring, threading and unloading — is only 15 minutes.

Jones & Lamson Turret Lathes are available with: Completely automatic controls; 45°, 60°, and 180° Tracers; taper attachments, and a variety of other tooling complements, all designed to increase productivity.

Write for detailed information, Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

TABLE FOR CONVERTING DECIMALS OF A RADIAN INTO DEGREES, MINUTES, AND SECONDS—2

Decimal of Radian	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.360	20°37′35.33″	20°41′01.59″	20°44′27.86″	20°47′54.12″	20°51′20.39″	20°54′46.65″	20°58′12.92″	21°01′39.18″	21°05′05.45″	21°08′31.71″
0.370	21°11′57.98″	21°15′24.24″	21°18′50.51″	21°22′16.77″	21°25′43.04″	21°29′09.30″	21°32′35.57″	21°36′01.83″	21°39′28.10″	21°42′54.36″
0.380	21°46′20.62″	21°49′46.89″	21°53′13.15″	21°56′39.42″	22°00′05.68″	22°03′31.95″	22°06′58.21″	22°10′24.48″	22°13′50.74″	22°17′17.01″
0.390	22°20′43.27″	22°24′09.54″	22°27′35.80″	22°31′02.07″	22°34′28.33″	22°37′54.60″	22°41′20.86″	22°44′47.13″	22°48′13.39″	22°51′39.66″
0.400	22°55′05.92″	22°58′32.19″	23°01′58.45″	23°05′24.72″	23°08′50.98″	23°12′17.24″	23°15′43.51″	23°19′09.77″	23°22′36.04″	23°26′02.30″
0.410	23°29′28.57″	23°32′54.83″	23°36′21.10″	23°39′47.36″	23°43′13.63″	23°46′39.88″	23°50′06.16″	23°53′32.42″	23°56′58.69″	24°00′24.95″
0.420	24°03′51.22″	24°07′17.48″	24°10′43.75″	24°14′10.01″	24°17′36.28″	24°21′02.54″	24°24′28.81″	24°27′55.07″	24°31′21.34″	24°34′47.60″
0.430	24°38′13.86″	24°41′40.13″	24°45′06.39″	24°48′32.66″	24°51′58.92″	24°55′25.19″	24°58′51.45″	25°02′17.72″	25°05′43.98″	25°09′10.25″
0.440	25°12′36.51″	25°16′02.78″	25°19′29.04″	25°22′55.31″	25°26′21.57″	25°29′47.84″	25°33′14.10″	25°36′40.37″	25°40′06.63″	25°43′32.90″
0.450	25°46′59.16″	25°50′25.43″	25°53′51.69″	25°57′17.96″	26°00′44.22″	26°04′10.48″	26°07′36.75″	26°11′03.01″	26°14′29.28″	26°17′55.54″
0.460	26°21′21.81″	26°24′48.07″	26°28′14.34″	26°31′40.60″	26°35′06.87″	26°38′33.13″	26°41′59.40″	26°45′25.66″	26°48′51.93″	26°52′18.19″
0.470	26°55′44.46″	26°59′10.72″	27°02′36.99″	27°06′03.25″	27°09′29.52″	27°12′55.78″	27°16′22.05″	27°19′48.31″	27°23′14.58″	27°26′40.84″
0.480	27°30′07.10″	27°33′33.37″	27°36′59.63″	27°40′25.90″	27°43′52.16″	27°47′18.43″	27°50′44.69″	27°54′10.96″	27°57′37.22″	28°01′03.49″
0.490	28°04′29.75″	28°07′56.02″	28°11′22.28″	28°14′48.55″	28°18′14.81″	28°21′41.08″	28°25′07.34″	28°28′33.61″	28°31′59.87″	28°35′26.14″
0.500	28°38′52.40″	28°42′18.67″	28°45′44.93″	28°49′11.20″	28°52′37.46″	28°56′03.73″	28°59′30.00″	29°02′56.26″	29°06′22.52″	29°09′48.79″
0.510	29°13′15.05″	29°16′41.32″	29°20′07.58″	29°23′33.85″	29°27′00.11″	29°30′26.38″	29°33′52.64″	29°37′18.90″	29°40′45.17″	29°44′11.43″
0.520	29°47′37.70″	29°51′03.96″	29°54′30.23″	29°57′56.49″	30°01′22.76″	30°04′49.02″	30°08′15.29″	30°11′41.55″	30°15′07.82″	30°18′34.08″
0.530	30°22′00.35″	30°25′26.61″	30°28′52.88″	30°32′19.14″	30°35′45.41″	30°39′11.67″	30°42′37.94″	30°46′04.20″	30°49′30.47″	30°52′56.73″
0.540	30°56′23.00″	30°59′49.26″	31°03′15.52″	31°06′41.79″	31°10′08.05″	31°13′34.32″	31°17′00.58″	31°20′26.85″	31°23′53.11″	31°27′19.38″
0.550	31°30′45.64″	31°34′11.91″	31°37′38.17″	31°41′04.44″	31°44′30.70″	31°47′56.97″	31°51′23.23″	31°54′49.50″	31°58′15.76″	32°01′42.03″
0.560	32°05′08.29″	32°08′34.56″	32°12′00.82″	32°15′27.09″	32°18′53.35″	32°22′19.62″	32°25′45.88″	32°29′12.14″	32°32′38.41″	32°36′04.67″
0.570	32°39′30.94″	32°42′57.20″	32°46′23.47″	32°49′49.73″	32°53′16.00″	32°56′42.26″	33°00′08.53″	33°03′34.79″	33°07′01.06″	33°10′27.32″
0.580	33°13′53.58″	33°17′19.85″	33°20′46.12″	33°24′12.38″	33°27′38.65″	33°31′04.91″	33°34′31.18″	33°37′57.44″	33°41′23.71″	33°44′49.97″
0.590	33°48′16.24″	33°51′42.50″	33°55′08.76″	33°58′35.03″	34°02′01.29″	34°05′27.56″	34°08′53.82″	34°12′20.09″	34°15′46.35″	34°19′12.61″
0.600	34°22′38.88″	34°26′05.15″	34°29′31.41″	34°32′57.68″	34°36′23.94″	34°39′50.21″	34°43′16.47″	34°46′42.74″	34°50′09.00″	34°53′35.27″
0.610	34°57′01.53″	35°00′27.80″	35°03′54.06″	35°07′20.33″	35°10′46.59″	35°14′12.86″	35°17′39.12″	35°21′05.38″	35°24′31.65″	35°27′57.91″
0.620	35°31′24.18″	35°34′50.44″	35°38′16.71″	35°41′42.97″	35°45′09.24″	35°48′35.50″	35°52′01.77″	35°55′28.03″	35°58′54.30″	36°02′20.56″
0.630	36°05′46.83″	36°09′13.09″	36°12′39.36″	36°16′05.62″	36°19′31.89″	36°22′58.15″	36°26′24.42″	36°29′50.67″	36°33′16.94″	36°36′43.20″
0.640	36°40′09.47″	36°43′35.73″	36°47′01.99″	36°50′28.26″	36°53′54.52″	36°57′20.79″	37°00′47.05″	37°04′13.32″	37°07′39.58″	37°11′05.85″
0.650	37°14′32.11″	37°17′58.38″	37°21′24.64″	37°24′50.91″	37°28′17.17″	37°31′43.44″	37°35′09.70″	37°38′35.97″	37°42′02.23″	37°45′28.50″
0.660	37°48′54.76″	37°52′21.03″	37°55′47.29″	37°59′13.56″	38°02′39.82″	38°06′06.09″	38°09′32.35″	38°12′58.61″	38°16′24.88″	38°19′51.14″
0.670	38°23′17.41″	38°26′43.67″	38°30′09.94″	38°33′36.20″	38°37′02.47″	38°40′28.73″	38°43′55.00″	38°47′21.26″	38°50′47.53″	38°54′13.79″
0.680	38°57′40.06″	39°01′06.32″	39°04′32.59″	39°07′58.85″	39°11′25.12″	39°14′51.38″	39°18′17.65″	39°21′43.91″	39°25′10.18″	39°28′36.44″
0.690	39°32′02.71″	39°35′28.97″	39°38′55.23″	39°42′21.50″	39°45′47.76″	39°49′14.03″	39°52′40.29″	39°56′06.56″	39°59′32.82″	40°02′59.09″
0.700	40°06′25.35″	40°09′51.62″	40°13′17.88″	40°16′44.15″	40°20′10.41″	40°23′36.68″	40°27′02.94″	40°30′29.21″	40°33′55.47″	40°37′21.74″

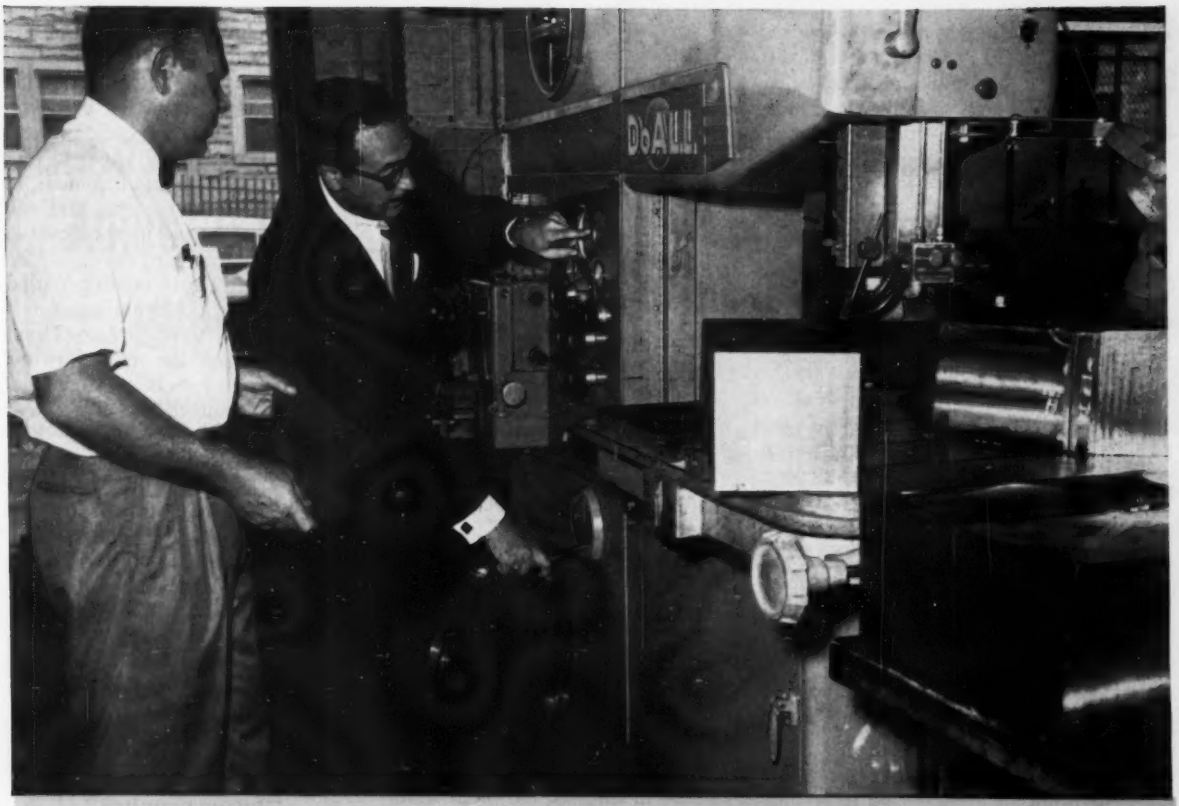
Note: Continued from MACHINERY's Data Sheet for October, 1959.

Compiled by D. E. Lewis, Devon, England

TABLE FOR CONVERTING DECIMALS OF A RADIAN INTO DEGREES, MINUTES, AND SECONDS—3

Decimal of Radian	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.710	40°40′48.00″	40°44′14.27″	40°47′40.53″	40°51′06.80″	40°54′33.06″	40°57′59.33″	41°01′25.59″	41°04′51.85″	41°08′18.11″	41°11′44.38″
0.720	41°15′10.65″	41°18′36.91″	41°22′03.18″	41°25′29.44″	41°28′55.71″	41°32′21.97″	41°35′48.24″	41°39′14.50″	41°42′40.77″	41°46′07.03″
0.730	41°49′33.30″	41°52′59.56″	41°56′25.83″	41°59′52.09″	42°03′18.36″	42°06′44.62″	42°10′10.89″	42°13′37.15″	42°17′03.42″	42°20′29.68″
0.740	42°23′55.95″	42°27′22.21″	42°30′48.47″	42°34′14.74″	42°37′41.00″	42°41′07.27″	42°44′33.53″	42°47′59.80″	42°51′26.06″	42°54′52.33″
0.750	42°58′18.60″	43°01′44.87″	43°05′11.13″	43°08′37.40″	43°12′03.66″	43°15′29.93″	43°18′56.19″	43°22′22.46″	43°25′48.72″	43°29′14.99″
0.760	43°32′41.25″	43°36′07.52″	43°39′33.78″	43°43′00.05″	43°46′26.31″	43°49′52.58″	43°53′18.84″	43°56′45.11″	44°00′11.37″	44°03′37.64″
0.770	44°07′03.90″	44°10′30.17″	44°13′56.43″	44°17′22.70″	44°20′48.96″	44°24′15.22″	44°27′41.49″	44°31′07.75″	44°34′34.02″	44°38′00.28″
0.780	44°41′26.55″	44°44′52.81″	44°48′19.08″	44°51′45.34″	44°55′11.61″	44°58′37.87″	45°02′04.14″	45°05′30.40″	45°08′56.67″	45°12′22.93″
0.790	45°15′49.20″	45°19′15.46″	45°22′41.73″	45°26′07.99″	45°29′34.26″	45°33′00.52″	45°36′26.79″	45°39′53.05″	45°42′19.32″	45°46′45.58″
0.800	45°50′11.84″	45°53′38.11″	45°57′04.37″	46°00′30.64″	46°03′56.90″	46°07′23.17″	46°10′49.43″	46°14′15.70″	46°17′41.96″	46°21′08.22″
0.810	46°24′34.49″	46°28′00.75″	46°31′27.02″	46°34′53.28″	46°38′19.55″	46°41′45.81″	46°45′12.08″	46°48′38.34″	46°52′04.61″	46°55′30.87″
0.820	46°58′57.14″	47°02′23.40″	47°05′49.67″	47°09′15.93″	47°12′42.20″	47°16′08.46″	47°19′34.73″	47°23′00.99″	47°26′27.26″	47°29′53.52″
0.830	47°33′19.79″	47°36′46.05″	47°40′12.32″	47°43′38.58″	47°47′04.85″	47°50′31.11″	47°53′57.38″	47°57′23.64″	48°00′49.91″	48°04′16.17″
0.840	48°07′42.44″	48°11′08.70″	48°14′34.97″	48°18′01.23″	48°21′27.50″	48°24′53.76″	48°28′20.03″	48°31′46.29″	48°35′12.56″	48°38′38.82″
0.850	48°42′05.09″	48°45′31.35″	48°48′57.61″	48°52′23.88″	48°55′50.14″	48°59′16.41″	49°02′42.67″	49°06′08.94″	49°09′35.20″	49°13′01.47″
0.860	49°16′27.73″	49°19′54.00″	49°23′20.26″	49°26′46.53″	49°30′12.79″	49°33′39.06″	49°37′05.32″	49°40′31.59″	49°43′57.85″	49°47′24.12″
0.870	49°50′50.38″	49°54′16.65″	49°57′42.91″	50°01′09.18″	50°04′35.44″	50°08′01.71″	50°11′27.97″	50°14′54.24″	50°18′20.50″	50°21′46.76″
0.880	50°25′13.03″	50°28′39.29″	50°32′05.56″	50°35′31.82″	50°38′58.09″	50°42′24.35″	50°45′50.62″	50°49′16.88″	50°52′43.15″	50°56′09.41″
0.890	50°59′35.68″	51°03′01.94″	51°06′28.21″	51°09′54.47″	51°13′20.74″	51°16′47.00″	51°20′13.27″	51°23′39.53″	51°27′05.80″	51°30′32.06″
0.900	51°33′58.33″	51°37′24.57″	51°40′50.86″	51°44′17.12″	51°47′43.38″	51°51′09.65″	51°54′35.91″	51°58′02.18″	52°01′28.44″	52°04′54.71″
0.910	52°08′20.97″	52°11′47.24″	52°15′13.50″	52°18′39.77″	52°22′06.03″	52°25′32.30″	52°28′58.56″	52°32′24.83″	52°35′51.09″	52°39′17.36″
0.920	52°42′43.62″	52°46′09.89″	52°49′36.15″	52°53′02.42″	52°56′28.68″	52°59′54.95″	53°03′21.21″	53°06′47.48″	53°10′13.74″	53°13′40.00″
0.930	53°17′06.27″	53°20′32.53″	53°23′58.80″	53°27′25.06″	53°30′51.33″	53°34′17.59″	53°37′43.86″	53°41′10.12″	53°44′36.39″	53°48′02.65″
0.940	53°51′28.92″	53°54′55.18″	53°58′21.45″	54°01′47.71″	54°05′13.98″	54°08′40.24″	54°12′06.51″	54°15′32.77″	54°18′59.04″	54°22′25.30″
0.950	54°25′51.57″	54°29′17.83″	54°32′44.10″	54°36′10.36″	54°39′36.63″	54°43′02.89″	54°46′29.15″	54°49′55.42″	54°53′21.68″	54°56′47.95″
0.960	55°00′14.21″	55°03′40.48″	55°07′06.74″	55°10′33.01″	55°13′59.27″	55°17′25.54″	55°20′51.80″	55°24′18.07″	55°27′44.33″	55°31′10.60″
0.970	55°34′36.86″	55°38′03.13″	55°41′29.39″	55°44′55.66″	55°48′21.92″	55°51′48.19″	55°55′14.45″	55°58′40.72″	56°02′06.98″	56°05′33.25″
0.980	56°08′59.51″	56°12′25.77″	56°15′52.04″	56°19′18.30″	56°22′44.57″	56°26′10.83″	56°29′37.10″	56°33′03.36″	56°36′29.63″	56°39′55.89″
0.990	56°43′22.16″	56°46′48.42″	56°50′14.69″	56°53′40.95″	56°57′07.22″	57°00′33.48″	57°03′59.75″	57°07′26.01″	57°10′52.28″	57°14′18.54″
1.000	57°17′44.8062″									

Compiled by D. E. Lewis, Devon, England



Your DoALL sawing specialist can help you get all the benefits of band machining

Laneko Engineering Company of Philadelphia has had wide experience in the contour cutting of metals with DoALL Band Saws. They used a DoALL Model V-36 and were well satisfied with the results. Then they added a new DoALL 26-3 and overnight graduated from band sawing to band machining.

In a typical test Bill Cole, sawing specialist of the DoALL Philadelphia Company, demonstrated that band machining could deliver tremendous savings in cutting time. The job, shown in the photo, consisted of contour cutting a block of AISI#4140 steel, 6½" x 6½" x 17". Formerly this took 10½ hours. With a power table replacing the old hand feed and following Bill Cole's recommendation of using a Demon* HSS Blade, the job was completed in just three hours—a 72% saving in time alone.

There are more than 200 DoALL Sawing Specialists from coast to coast experienced in cutting production costs with band machining. Call your DoALL Specialist today. His expert help—plus the help of the DoALL Research Laboratory—is free.

*Reg. T.M.—The DoALL Company

Large photo: Bill Cole of DoALL Philadelphia Company discussing proper feed, speed and blade with Mr. William Neff, Jr. (left) of Laneko Engineering Company. Small photo: both V-36 and new 26-3 DoALL Band Saws working side by side at Laneko.

SB-81

THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

For more data, circle this page number on inquiry card

in diesel-engine generator houses; bio-acoustic testing laboratories; artillery or missile launching sites; steel rolling mills; punch-press rooms; and many other industrial fields.

Circle Item 605 on postcard, page 191

Swivel Base for Dividing Heads

A swivel base is now available for all models of the complete line of L-W dividing heads made by the L-W Chuck Co., Toledo, Ohio. This swivel base converts the dividing heads to a fully universal type. All L-W dividing heads have a ball bearing to take the thrust on the worm-shaft and at the rear end of the spindle. The headstock spindle is provided with a threaded nose. There is also a large tapered bearing which is adjustable for end play. The head tilts past a 90-degree angle. The worm-wheel and alloy stressproof steel worm are made to close tolerances.

Each dividing head comes complete with three index-plates for dividing all numbers up to 50 and even numbers to 100 with the exception of number 96. An index chart shows all divisions obtainable up to 380. The Model SD dividing head has a 6 1/2-inch swing; Model BP, an 11-inch swing; and Model AU of the fully universal

Swivel base for dividing heads made by the L-W Chuck Co.

type designed for complete indexing and spiral cutting has a swing of 11 inches.

Circle Item 606 on postcard, page 191

Retractable-Cutter Bar Turner

A retractable-cutter bar turner for use in single-spindle bar automatics is announced by the Warner & Swasey Co., Cleveland, Ohio. This turner is designed for use in the manufacturer's 2AB single-spindle bar automatic machines. Highly efficient metal removal with exceptionally close tolerances and smooth, burnished work finishes are advantages claimed for this tool. Automatic cutter retraction and resetting is said to eliminate tool-withdrawal marks and prolong cutter life. The tool is capable of handling bars from 1/2 inch to 2 3/4 inches in diameter and can be clamped directly in the dovetail of the pentagon turret.

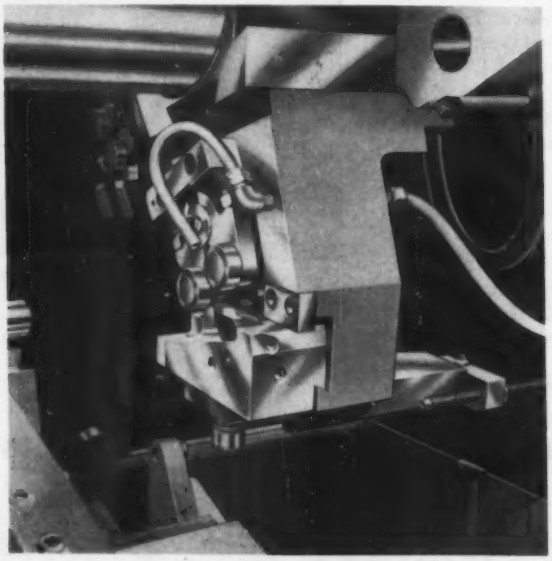
When cutting, the spring-loaded tool-holder slide bears against a spring-loaded stepped cam. Upon completion of the cut, forward motion of this cam is arrested when a screw—connected to the cam—strikes a special stop positioned on the front cross-slide housing of the machine. The pentagon turret then continues to feed forward about 1/8 inch to the end of its stroke, sliding the turner's tool-slide off the cam and retracting the cutter.

The cam and cutter are automatically reset in an off-index position by an overhead-mounted resetting cam.

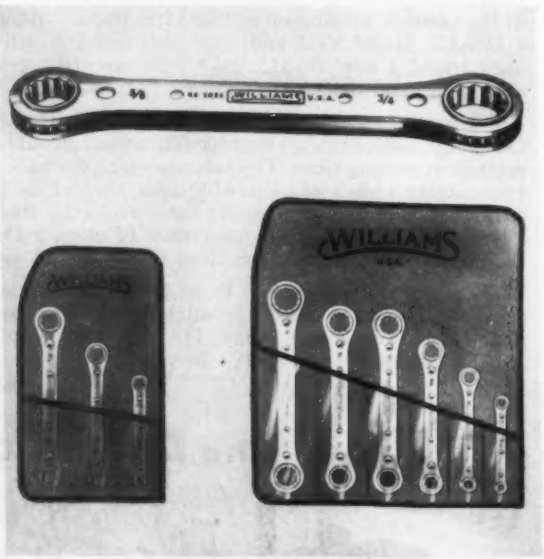
Circle Item 607 on postcard, page 191

Ratcheting Box "Superrenches"

Six sizes of ratcheting box "Superrenches" with 6- and 12-point openings from 1/4 to 7/8 inches have recently been added to the line manufactured by J. H. Williams & Co., Buffalo, N. Y. These



Warner & Swasey retractable cutter for single-spindle automatics



Williams ratcheting box "Superrenches" available in six sizes

General Electric announces the new Adjust-O-Breaker toolholder!

Carboloy® toolholder with adjustable chipbreaker lets you adjust from any angle . . . offers any desired adjustment within its range* . . . features "floating" indexable chipbreaker with absolute repeatability.

MORE jobs with *LESS* tooling—that's what you get with this new Carboloy® Adjust-O-Breaker toolholder! No need to have a separate chipbreaker for every cutting job. No need to restrict yourself to toolholders with only two or three chipbreaker settings. Now you can have this versatile new Carboloy toolholder . . . and *adjust it for any chipbreaker setting within its range.**

Available right now from stock in 5 styles, negative rake, for left- and right-hand machining, the Adjust-O-Breaker truly brings new meaning to disposable tooling.

So, to get cutting tool versatility that lets you handle *more* jobs with *less* tooling, check into the complete Carboloy line—Lift-O-Matic (positive rake, negative rake, and tracer), heavy-duty, and the new Adjust-O-Breaker toolholder. The complete line of Carboloy inserts, insert seats, convertible seats, and brazed tooling is the *broadest* in the industry . . . designed to meet *every* tooling need to give you BETTER PROFITS THROUGH BETTER TOOLING.

See your Authorized Carboloy Distributor now. He's listed in the Yellow Pages. *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Road, Detroit 32, Michigan.*

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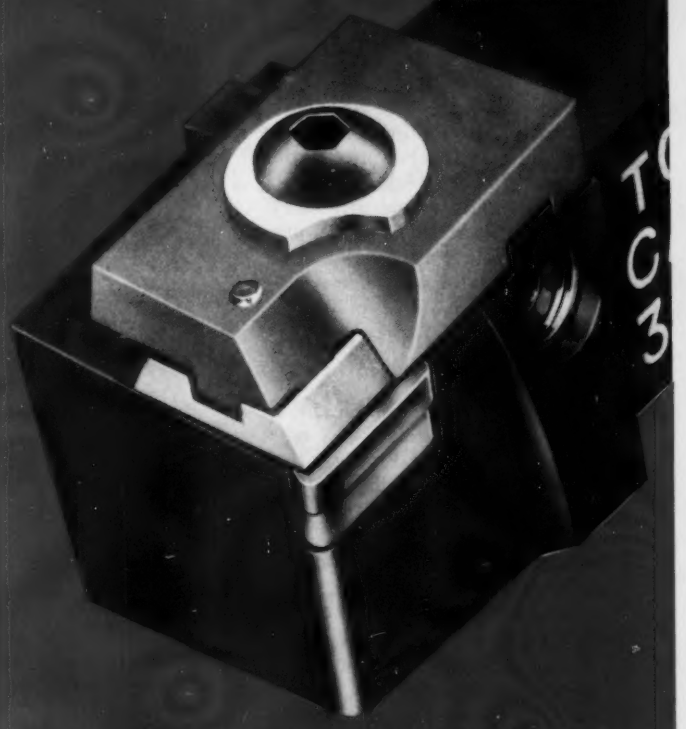
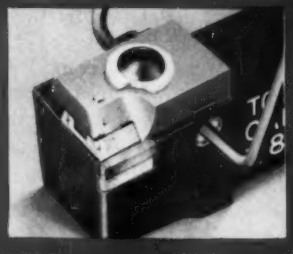
CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

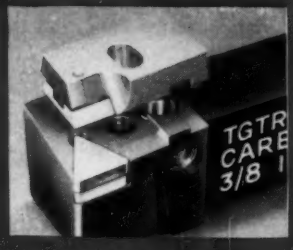
Metallurgical Memo from General Electric



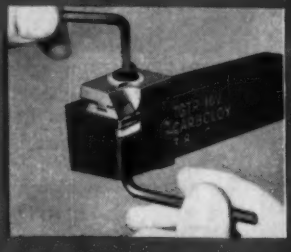
"Sizes 16V and 85V: adjustable range 1/16" to 3/16"
Size 20V: adjustable range 1/16" to 1 1/32"



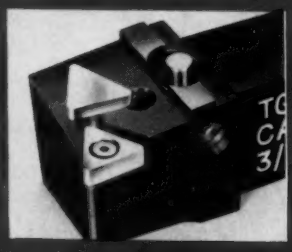
1. Chipbreaker setting adjusts to any width within range.* Set screw with two open ends provides access from either side. No springs to adjust.



2. Design permits absolute repeatability of settings. Floating chipbreaker is indexable. Can't drop out when clamp is loosened.



3. Clamp screw is accessible from top or bottom; allows easy indexing or replacement even when toolholder is vertical or upside down.



4. Standard disposable inserts, Carboloy insert seats and convertible seat are used with toolholder. Insert seats are indexable and self-aligning.

For more data, circle this page number on inquiry card

wrenches are designed to permit nuts and bolts to be turned faster and easier than is possible with preceding styles. The openings are accurately broached to properly fit the nuts.

All critical parts are made of selected alloy steel and are heat-treated for long-lasting service and safety. The wrenches are chromium-plated over nickel. In addition to being sold individually, these Superrenches are available in plastic leatherette rolls as illustrated.

Circle Item 608 on postcard, page 191

Comparator for Use with Any Dial Indicator

A comparator adaptable to all types of dial indicators has been designed by Petz-Emery, Inc., Pleasant Valley, N. Y. This Model A comparator can be supplied with any of the sixty-seven "Em-re" dial indicators. Supplied alone, it can be equipped with an adapter to accommodate any other make of dial indicator that has a conventional type back. Coarse adjustment is made by sliding the indicator mount up and down the column and clamping it in position. Fine adjustment is then made by rotating the left-hand knob in either direction. When adjusted, the mount is locked in position by turning the right-hand knob. The standard Model A comparator is equipped with a 1 3/4-inch-diameter ground stainless-steel column. There is a 3 3/8-inch clearance between column and contact point. Vertical capacity above the anvil is 3 5/8 inches. Other models are also available with 5 5/8-inch and 7 5/8-inch vertical capacities.

Petz-Emery comparator with dial indicator

Circle Item 609 on postcard, page 191

Building-Block Spindle and Slide Units

A building-block system using super-precision spindles, slides, and feeding or traversing mechanisms with other commercial components to provide efficient production equipment has been developed by the Standard Electrical Tool Co., Cincinnati, Ohio.

Attrition grinder unit developed by the Standard Electrical Tool Co.

The accompanying illustration shows an assembly of catalogue items of the building-block system that provides the basic portion of an attrition grinder. The No. 4408 super-precision I-block grinding spindle includes a coaxial shaft with coaxial rotary joint for water cooling through the shaft to the vacuum-seal mounting on the spindle nose. The I-block spindle has an integral top platform to permit substantial piggy-back assembly of the 30-hp, totally enclosed, fan-cooled motor which has a speed of 1800 rpm. Power is transmitted through a timer-belt drive with speed changes between 900 and 1800 rpm. The piggy-back assembly is positioned on a standard No. IGY slide having a 4-inch rapid reverse traverse.

Building-block catalogue units in sizes to supply power ranging from fractional horsepower up to 200 hp permits assembly in "endless variations."

Circle Item 610 on postcard, page 191

Fig. 1. Microbore-Kendex screw-on type throw-away insert

Tool-Holders with Throw-Away Inserts

A specially designed combination of Microbore cutting tool-holders with Kendex throw-away inserts has been announced by the Microbore Division, DeVlieg Machine Co., Royal Oak, Mich. Drastic reductions in replacement costs plus fast indexing are two important features claimed for this tool equipment. It is said to be particularly well-suited for rough cutting with its new arrangement of triangular Kennametal Kendex, mechanically held throw-away inserts. These inserts can be provided in the hardest grades of carbides because no brazing is required.

The Microbore tool-holder has a rugged micrometer vernier that

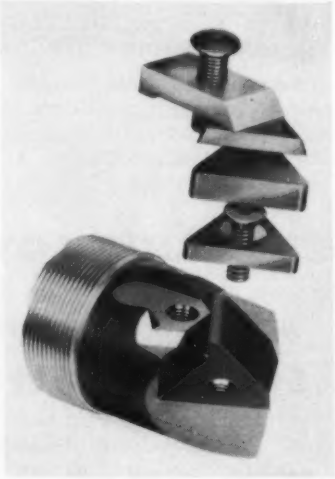


Fig. 2. Clamp-on type Microbore-Kendex throw-away insert

NEW *from* GRAND RAPIDS

No. 350 PRECISION TOOL ROOM TYPE HYDRAULIC FEED SURFACE GRINDER

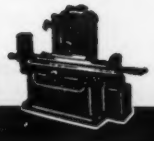
and just look at all these features:

11286 Schmidt & Sefton Adv — 40-2

- Powered vertical movement of wheel head*
- Instantly variable hydraulic table speed
- Greased-for-life precision ball bearing spindle with two speeds for long wheel life
- Equipped with Vickers vane type pump and our own control valve for infinite longitudinal table speeds from 5″ to 120′ per minute
- Variable speeds hydraulic cross feed and continuous cross feed
- Rugged, one-piece casting column and base for permanent rigid alignment
- Bijur one-shot lubricating system eliminating hand oiling
- Ultimate in accuracy with micro inch finish at production speeds

**AUTOMATIC DOWNFEED AVAILABLE AS OPTIONAL FEATURE*

For full details, just send a note on your letterhead.



GALLMEYER & LIVINGSTON

GALLMEYER & LIVINGSTON CO.
305 Straight Ave., S.W., Grand Rapids, Mich.

For more data, circle this page number on inquiry card

is adjustable to seconds. The triangular Kendex throw-away inserts can be indexed from tip to tip to provide three different cutting edges. When all three edges are dull the insert is thrown away. Thus, costs of regrinding are completely eliminated because a replacement tip is merely put in place and held there by a screw-on button or clamp. Figs. 1 and 2 show the two types of insert fastenings available.

Circle Item 611 on postcard, page 191

Metal Bowl for Air-Line Filters and Lubricators

High-strength drawn steel bowl for Schrader air-line filters and lubricators now available from A. Schrader's Son, Division Scovill Mfg. Co., Brooklyn, N. Y. This metal bowl is said to open many new applications for both air-filtering and lubricating units. These units can now be used more safely at pressures well over the normal 100- to 120-psi air-line pressure. Temperatures up to 125 degrees F. are also handled easily. Metal bowls can be installed near heat-treat furnaces, paint-spray booths, compressors, and plastic molding machines, etc. They have also been specified for installation in exposed areas where there is danger of their being hit by personnel. The metal bowl is designed to handle line surges as well as carry-over oil from the compressor.

Circle Item 612 on postcard, page 191

"Kool-Vent" Face Shield

New concept in safety face shields that combines vision with ventilation, developed by American Optical Co., Southbridge, Mass. This shield is designed for use by industrial workers who require both visibility and face protection while working in heated areas. It incorporates an optically correct acetate window in a fine metal 24-mesh screen, 8 by 11 1/2 inches. The shield is held securely before the face by means of an adjustable fibre headband, enabling it to be worn with or without regular prescription eyeglasses. Acetate windows are available in clear, green, or aluminized.

Circle Item 613 on postcard, page 191

Skinner Three-Way Solenoid Valve

One of a series of high-flow, three-way, solenoid valves for general industrial use announced by Skinner Electric Valve Division, New Britain, Conn. The valves in this L3 series are designed to control such common media as oil, air, water, vegetable and petroleum oils, inert gases, kerosene, and gasoline. They are compact, light in weight, can be mounted in any position directly in the line, and operate on a pressure differential of 5 to 150 psi. These valves are being introduced in 3/8-, 1/2- and 3/4-inch effective orifice sizes, and are available in normally open and closed and directional-control types in standard and explosion-proof construction. Also, they are available in a wide range of voltages and frequencies with many electrical options.

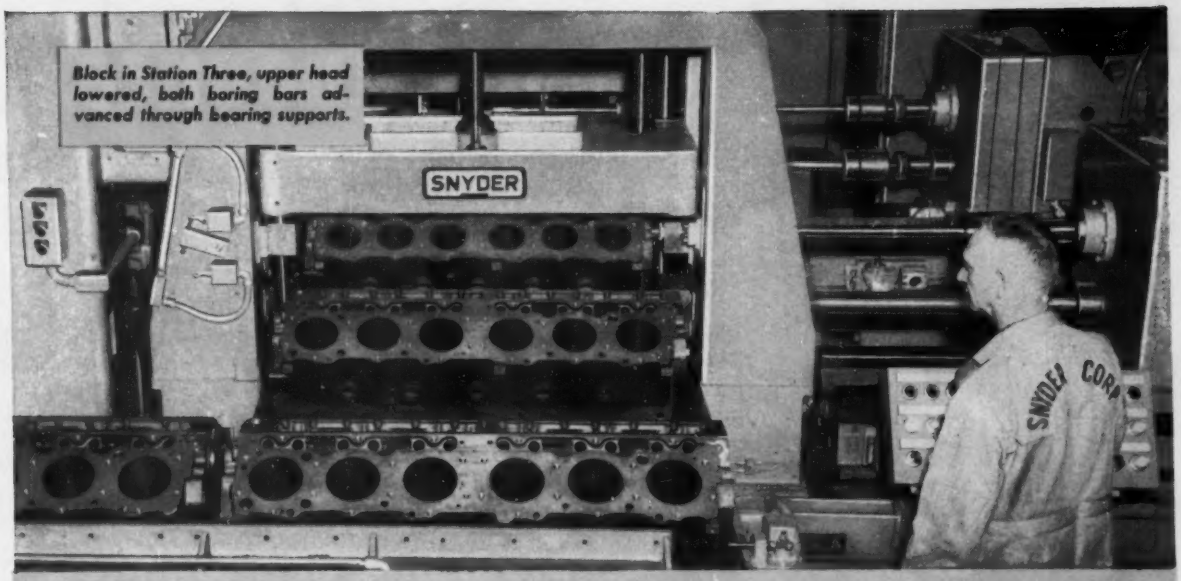
Circle Item 614 on postcard, page 191

Small-Parts Comparator

Wilder Model C small-parts comparator announced by Opto-Metric Tools, Inc., New York City. This comparator is designed for the rapid inspection of mass-produced parts with stage and screen so conveniently placed as to permit handling work with maximum speed and comfort. The instrument is furnished with its basic equipment only. A variety of magnifications, measuring stages, and master-gage charts is available to suit specific work. The comparator illustrated is equipped with special 2- by 4-inch range measuring stage with window-reading micrometers graduated to 0.0001 inch.

Circle Item 615 on postcard, page 191

(*This section continued on page 216*)



Block in Station Three, upper head lowered, both boring bars advanced through bearing supports.

PRECISION BORING OF 42″ LENGTH CAM AND CRANKSHAFT HOLES

SNYDERIZING Meets the Demand for Quality Parts for the Soaring Sixties

This 12-cylinder block is for heavy duty truck and marine engines aimed at taking a bigger bite of this booming market. Our Snyder special 7-station machine is helping this manufacturer SNYDERIZE for the Soaring Sixties by providing boring tolerances which make his product outstanding.

In regular production at a rate of 31 pieces per hour, main and camshaft bearing holes are rough and semi-finish bored simultaneously with all diameters held to manufacturers' specifications for alignment, roundness and concentricity. The distributor hole is also semi-finish bored in this machine to establish proper location to cam and crank bores.

Advanced engineering, both in product and production machines, is the best possible preparation for the competition of the next decade. We'll be happy to show you, too, how to SNYDERIZE for the Soaring Sixties to gain more efficient parts handling, gaging, assembly and machining. Write or phone for new brochure on machines for profit improvement.

Standard Features of Snyder Machines

1. SNYDER UNITS equipped with hardened and ground steel ways.
2. Building block principle throughout.
3. Automatic lubrication.
4. Walking beam transfer bar.
5. J.I.C. Standards throughout.
6. Electrical interlocks and full depth circuit throughout.
7. Panels equipped with SNYDER CIRCUIT SLEUTH.

SNYDER CORPORATION

(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

For more data, circle this page number on inquiry card

General Electric Announces Newest In The Complete Line Of Adjustable-Speed Drives

PARMATIC SPEED VARIATOR...newest in General Electric's complete line of packaged adjustable-speed drives . . . provides greater machine flexibility, better quality control, higher output and efficiency.

STATIC POWER

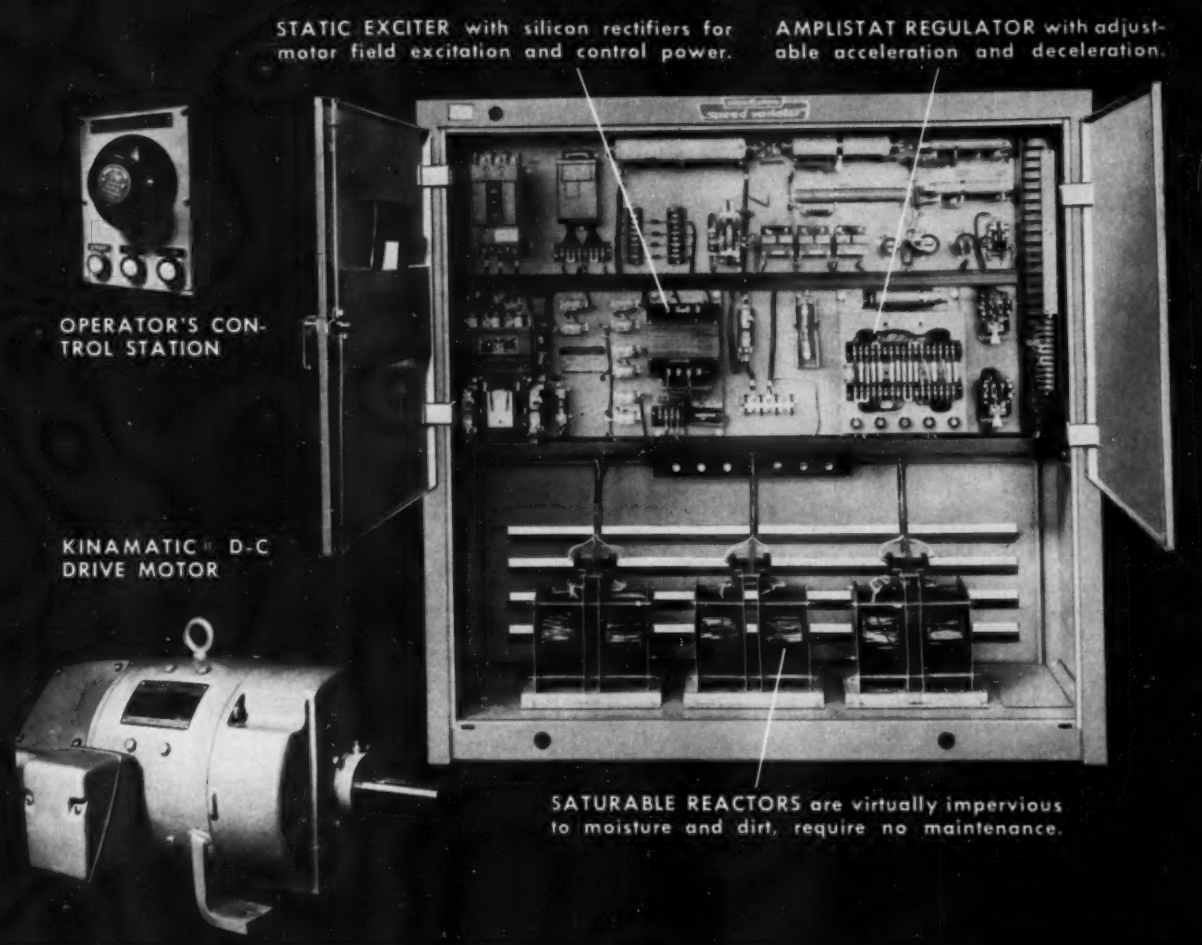
for less maintenance, less downtime, added profit. New excitation and power conversion systems have no rotating parts. Sealed silicon rectifiers and saturable reactors need no warm-up, virtually eliminate power unit maintenance.

25% SMALLER

for easier installation. Reliable, long-life G-E components are factory assembled in compact, space-saving power unit, wired and tested before installation to assure accurate control, reduced installation time and expense.

50% LIGHTER

for lower shipping and handling costs. New Speed Variator meets industry's demand for lighter, more powerful drives—packs more power, weighs 50% less than other drives of comparable rating, 2000 lbs less in 100-hp ratings.


STATIC EXCITER with silicon rectifiers for motor field excitation and control power.
AMPLISTAT REGULATOR with adjustable acceleration and deceleration.
OPERATOR'S CONTROL STATION
KINAMATIC® D-C DRIVE MOTOR
SATURABLE REACTORS are virtually impervious to moisture and dirt, require no maintenance.

FIELD PROVEN

by two years' impressive on-the-job performance in several hundred installations in 15 industries. Experience indicates high operating efficiency, lower cost installation and maintenance for a greater return on your investment.

- **GOOD SPEED REGULATION:** 5% with 100% load variation. Closer regulation available with modification.
- **WIDE SPEED RANGE:** Standard Parmatic Speed Variator provides 8 to 1 range or wider if required.
- **RESISTS CONTAMINATION:** Saturable reactors and hermetically sealed rectifiers resist dirt and moisture.
- **QUIET AND VIBRATIONLESS:** New power unit design eliminates noise and vibration—expands drive versatility.

Limitations: G-E Kinamatic Speed Variator with motor-generator set is recommended for applications requiring power absorption for stopping or overhauling loads. *For more information*, call your General Electric Sales Engineer, or write for GEA-7012, Section 821-1, General Electric Company, Direct Current Motor and Generator Department, 3001 East Lake Road, Erie, Pennsylvania.

GENERAL ELECTRIC

For more data, circle this page number on inquiry card

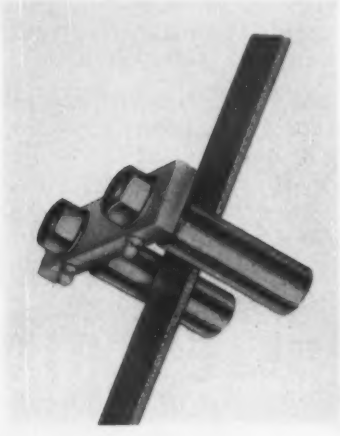
"Lo-Tork" Twist Drill

Twist drill designed to break chips to an easily manageable size to facilitate disposal, brought out by Chicago-Latrobe, Chicago, Ill. Breaking of the chips also eliminates clogging of the drill flutes and thus results in an increased flow of coolant to the drill point. Following are some of the advantages claimed for this "Lo-Tork" chip-breaker drill: (1) breaks and controls size of chips; (2) safe —eliminates stringy chip hazards; (3) retains positive rake at cutting lip; (4) penetrates easily—even on heavy-duty jobs; (5) permits continuous drilling; (6) reduces drilling time; and (7) assures longer tool life which reduces costs. "Lo-Tork" drills are available in sizes of 3/4 inch and larger in 110-LT regular taper-shank series or 120 LT straight-shank series.

Circle Item 616 on postcard, page 191

SKF Belt-Guide Roller

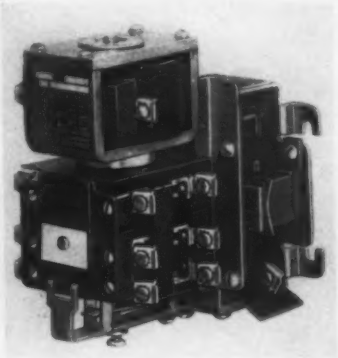
Antifriction guide for belts available from SKF Industries, Inc., Philadelphia, Pa. This belt guide is said to effect substantial power saving through reduced slippage, and to greatly increase belt life. The guide can be used at highest belt speeds and only requires relubrication after 20,000 hours of operation. It consists of one roller bearing and one ball bearing fitted in a sleeve so that their outer rings remain stationary. The bearings are sealed against lint and dirt. The elimination of inner rings makes it possible to have a larger and stronger guide which is adaptable for use wherever fork guides for belts are employed.



Circle Item 617 on postcard, page 191

Square D Direct-Current Relay

Mechanically held, direct-current relay added to the line of Type D relays for alternating-current and

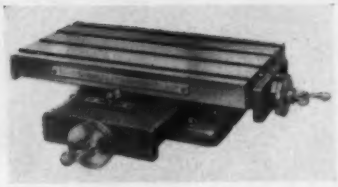


direct-current pilot controls manufactured by the Square D Co., Milwaukee, Wis. The mechanically held attachment mounts in a manner identical to the alternating-current attachment, and no additional panel space is required. The standard Type D electrically held direct-current relay is easily mounted directly on the attachment. Direct-current coils are available in a variety of voltages.

Circle Item 618 on postcard, page 191

Cook Cross-Slide Table

Precision cross-slide table introduced by Lawrence H. Cook, Inc., East Providence, R. I. This lightweight table is constructed of Meehanite iron castings. Its top and bottom are precision ground while all ways and gibs are hand-scraped. The table top is 8 by 12 inches, has four T-slots, and 6-inch scales on each slide. Dials are graduated from 0.001 to 0.050 inch per revolution. The heat-treated and precision-ground lead-screws

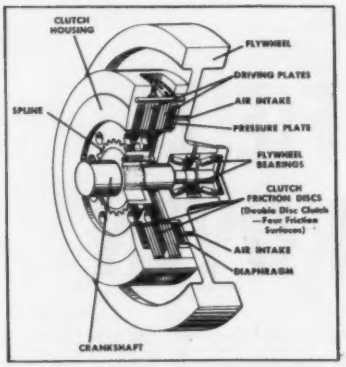


have 2 1/2-inch long bronze nuts. This new unit is only 15 inches long and 4 inches high. It can be used on rotary tables for radii- and angle-milling.

Circle Item 619 on postcard, page 191

Federal Air Clutch

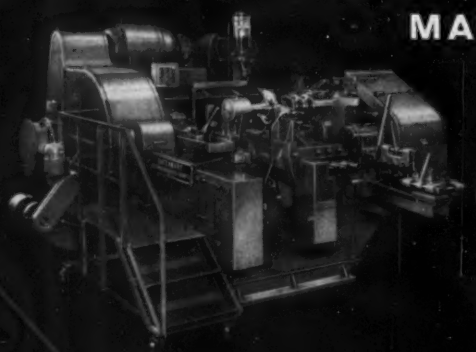
Self-adjusting disc type, low-inertia air clutch that operates on controlled air pressure and uniformly engages a full 360 degrees of friction surface. This clutch, introduced by the Federal Press Co., Elkhart, Ind., is designed to deliver the full torque at all times and to assure high-speed, shock-free action with less noise and low air consumption. A dual air solenoid valve, regulated by two interlocking control circuits, actuates the clutch through air intakes located in the flywheel. When the clutch is engaged, instant and total contact of the driving plates and friction discs is established with a mini-

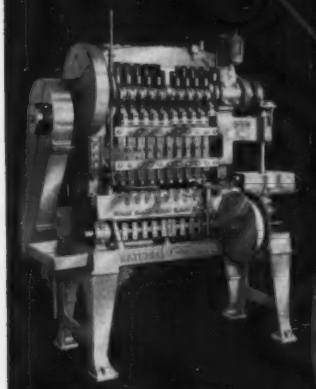


mum amount of movement. The flywheel mounting reduces the mass to be put into motion when the press is cycled, and the lack of any overlapping drag in the brake assures fast action in engaging and disengaging at any speed. Two hand- or foot-operated controls provide single-cycle, continuous, inching, emergency- and top-stop operation.

Circle Item 620 on postcard, page 191

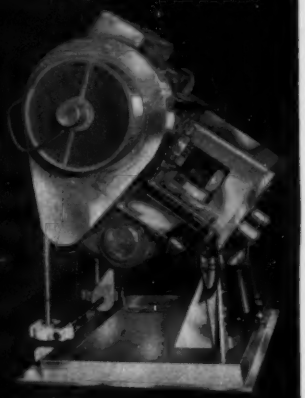
COLD HEADING
MACHINERY



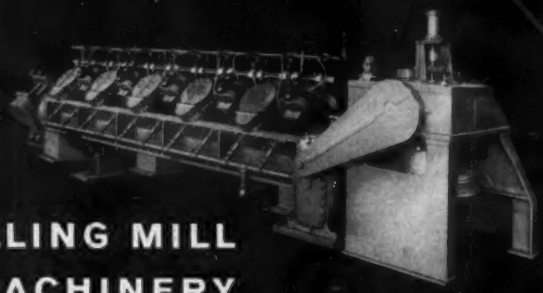


WATERBURY
MACHINERY BUILDERS
FARREL

POWER
PRESSES



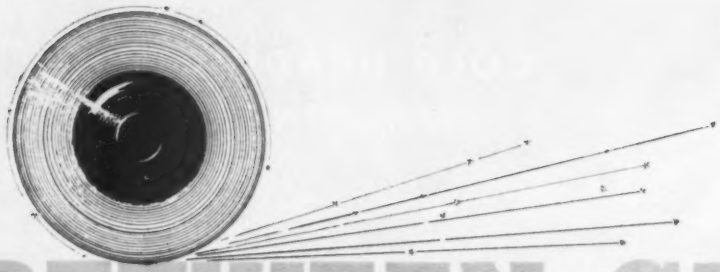
EYELET,
SLITTER
& WIRE
MACHINERY



ROLLING MILL
MACHINERY

THE WATERBURY FARREL FOUNDRY & MACHINE CO.
DIVISION OF TEXTRON INC.
Waterbury, Connecticut • U.S.A.
Sales Offices: Chicago • Cleveland • Los Angeles • Millburn, N. J.

WF-55



By E. S. Salichs

BETWEEN GRINDS

Pages Packed Punch

An article in MACHINERY, written by our editor, Charles O. Herb, became the subject of a cash prize contest not so long ago. It was entitled "How One New Machine Doubled a Small Company's Output," and described a Wiedemann turret type punching machine. The Wiedemann Machine Co. saw fit to make a reprint of the article, then to invite the sales personnel of its distributors to send in letters analyzing and interpreting sales features that could stem from the article.

From Start to Finis

A Long Island home-modernization company recently reported that about 300 home owners called on it annually for emergency help, but that in 90 per cent of these cases it was impossible to pick up where the do-it-yourself-er left off. One reason for the failures was poor cutting with inadequate tools, taking its toll, it would seem, in temper, time, and trouble, in whatsoever order you prefer.

Easy on the Editors

Early September was no time what with vacations, heat, and fall planning to ask editors on a tour of the Norma-Hoffmann Bearings Corporation to view a new operation, according to that company's agency, Burson-Marsteller Associates, Inc. Instead, "do-it-yourself" press kits presenting most of the facts that could be gleaned from such a tour were sent to editors. And an invitation to stop by the plant when in the Stamford area. A pleasure!

Now Hear This

"Hy-com" (highway communications) is an experimental low-frequency radio system demonstrated recently by the General Motors Research Laboratories and Delco Radio Division. It has two basic parts—low-frequency transmitters spaced along the highway and transistorized receivers in cars. Hy-com operates regardless of whether the car radio is turned on or not. Primarily, the voice from the road is a tip-off, an alert, or a brief warning, enough to let the driver know what to expect. Like—the state trooper is around the bend?

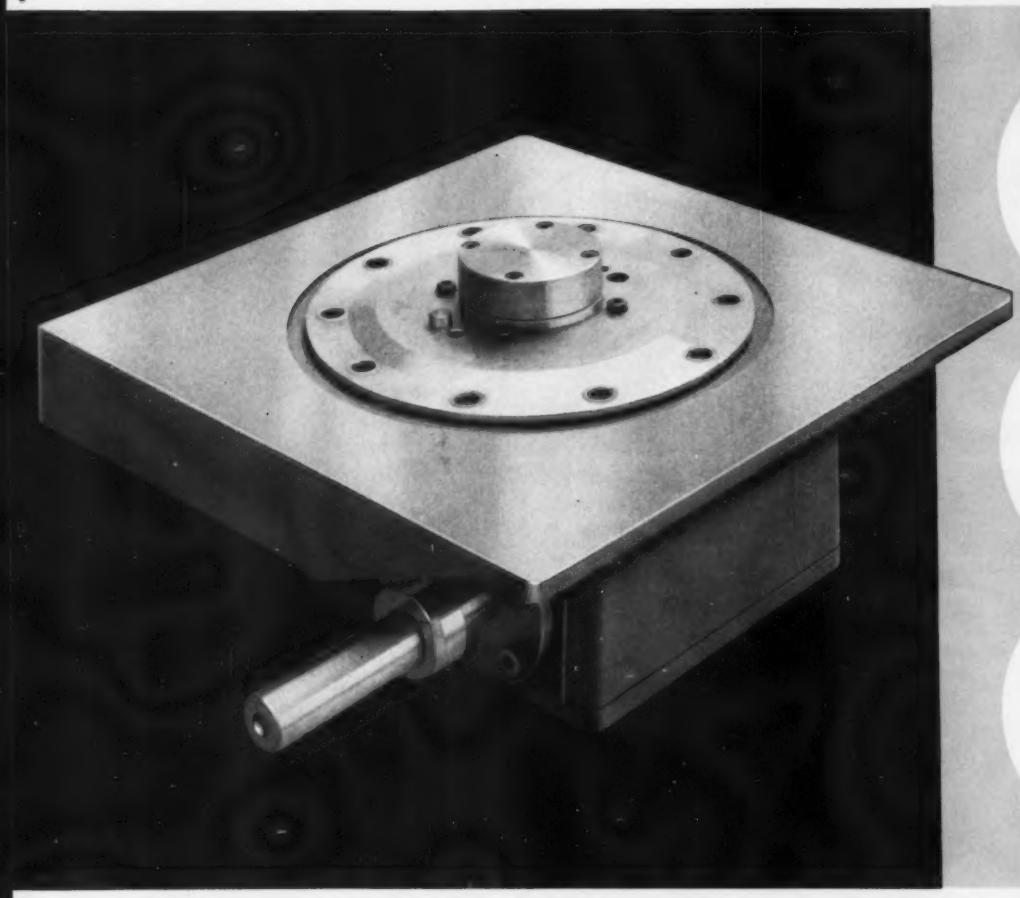
Buoyant Bars

Floating steel has been developed by the Crosley Division, Avco Mfg. Corporation. What next? Sinkproof wrist watches?

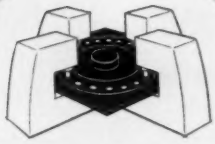
MR. STRASSER COMES TO TOWN—Federico Strasser, a long-time contributor to MACHINERY, recently made his first visit to the States, by reason of being the 1959 winner of the Presteel Award, which he received at the annual meeting of the Pressed Metal Institute on September 16. Mr. Strasser also dropped in at 93 Worth St. and met our editor, Charles O. Herb, and the editorial staff. Mr. Strasser has a cosmopolitan background—he was born in Hungary, took an electrical engineering degree in Milan, Italy, worked in Milan, then in Cologne, Germany. Since 1939, he has lived in Santiago, Chile, where he is a partner in a leading manufacturing concern that makes electrical items and plastics. Whence stem the many interesting articles he has had published in MACHINERY, his most recent contribution having just appeared in October under the title "How to Avoid Die-Plate Failures." Hasta la vista, Senor Strasser!

Economical, Versatile, Absolutely Accurate Automation!

Federal Dial Feed Indexing Table



Mount Indexing Table on your own presses



Use with drill presses, air cylinders, drills and tapping heads

Mount on all Federal Presses

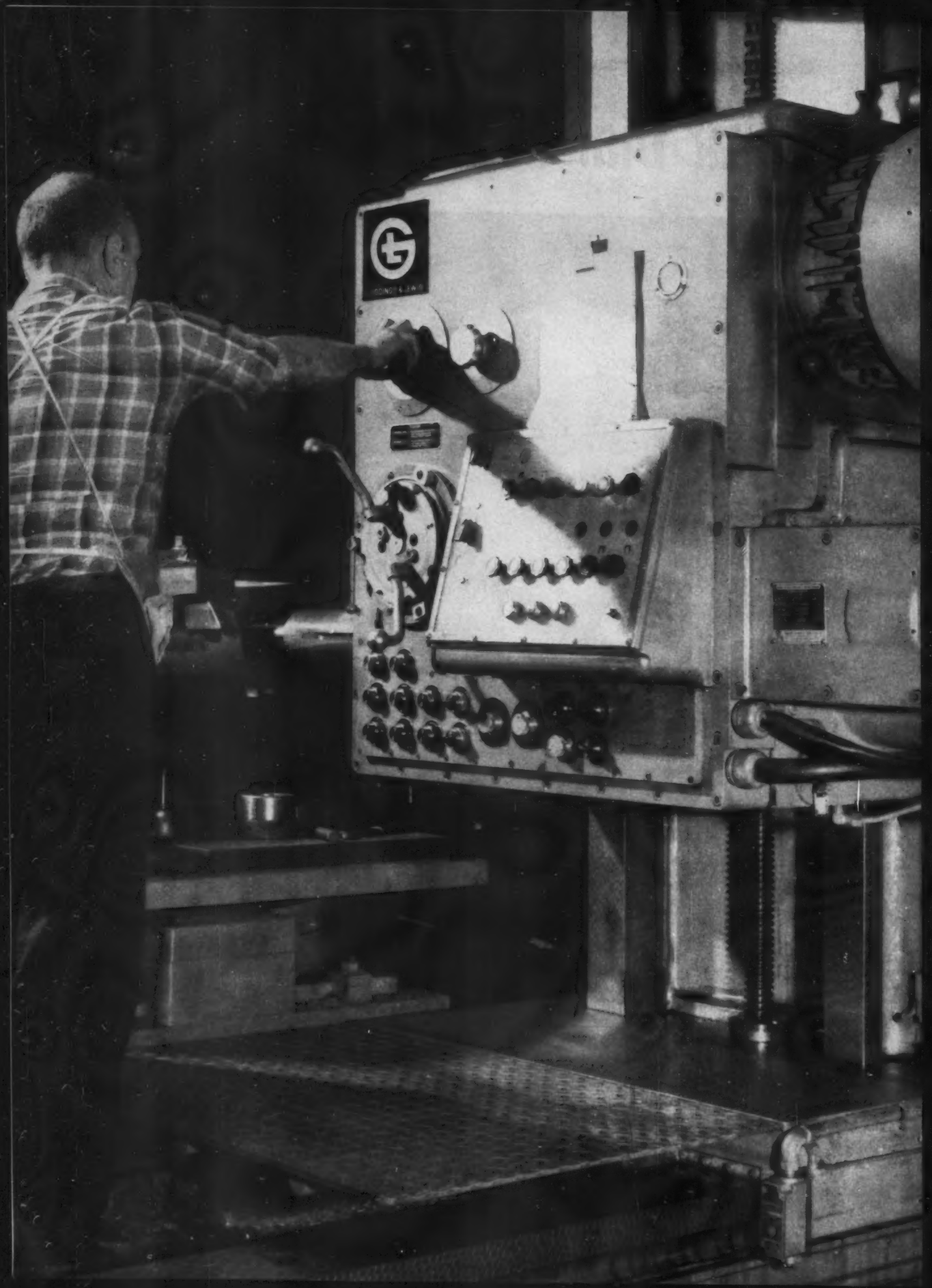
performs up to 300 indexes per minute!

The Federal Dial Feed Indexing Table performs hundreds of operations that formerly required specialized, high-priced equipment. Its application is limitless. Use on your present equipment, on Federal Presses, or independently with air cylinders, drills and tapping heads, or drill presses. The savings in tooling costs—in greatly increased production are almost unbelievable. Performs up to 20 multiple station operations—delivers up to 300 indexes per minute. Cam-type indexing mechanism assures perfect accuracy—smoothest operation. Absolute alignment is assured as "shot-pins" enter index holes after each index of the dial. A "safety pin" automatically stops press—*protecting the dies*—should misalignment occur for any reason. Gear or chain driven. Automatic parts feeder and ejector optional. For presses of up to 100-tons. Write for data, plus information on Federal's rebuilding facilities.

Federal Press Company, 901 Division Street, Elkhart, Indiana

FEDERAL *Open back Inclinable* PRESSES

35 Years of Quality Construction



Jigs and fixtures "traded" for tape

$44,954 savings first year

James Rowley, superintendent of the milling and grinding machine group at Brown & Sharpe Mfg. Co., Providence, Rhode Island, expects his new Giddings & Lewis tape-controlled horizontal boring, drilling, and milling machine to pay for itself in a hurry.

Savings in production hours are running at the rate of $8,594 per year on jobs like those illustrated at the right. On the same jobs, net savings in tooling have totaled $36,000.

Programing requires no special skills or capabilities — a knowledge of part layout and job setup is all that is required to prepare data. Programing and preparation of tapes for many jobs can be done within several hours.

Economic justification for the Numeripoint*-controlled G&L was an open and shut case when Brown & Sharpe faced the cost of tooling for production of a new line of machines. It quickly was determined that the tons of jigs and fixtures required could be "traded" for the new tape-controlled machine. Added advantages of tape: greatly reduced lead time, freedom to modify design almost at will because of the moderate cost involved, reduced handling, lower unit production cost, improved accuracy, and reduction in human error.

Giddings & Lewis tape-controlled horizontal boring, drilling, and milling machines are providing competitive advantage for manufacturers of power generation equipment, printing presses, construction machinery, machine tools, and transportation equipment.

The direct savings and plus-benefits of tape control are proved and ready for your company. For complete information and cost analysis, consult your local G&L distributor or write to GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wisconsin.

Giddings & Lewis Model 3045 horizontal boring, drilling, and milling machine with Numeripoint* control and rotary table.

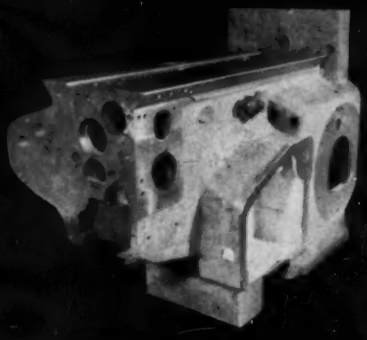
*Numeripoint is the G&L trade-mark for its punched tape discrete positioning system.

GIDDINGS & LEWIS

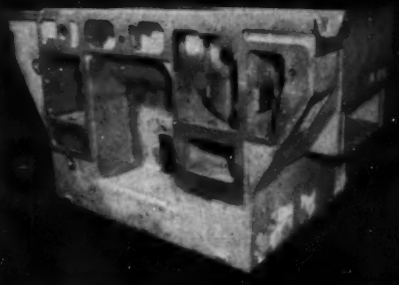
Giddings & Lewis manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

MBM-101

78% timesavings in machining arbor yokes.



42% savings in production time on this milling machine knee were achieved principally through reduction in handling.



38% savings in unit hours on this grinding machine bed proved the advantage of tape control over a specially set up rotary table machine.

50% savings in production time on these milling machine stands — milling, rough and finish boring, drilling, and tapping. Each of the four sides is machined automatically by 90° rotations of the table.

News OF THE INDUSTRY

California

NATIONAL ACME CO., Cleveland, Ohio, announced the purchase of the SHALCO CORPORATION of Palo Alto, Calif., through acquisition of capital stock, to operate as a wholly owned subsidiary of the parent machine tool company. Shalco Corporation is a developer and manufacturer of shell core and shell molding machines and related production foundry equipment. HERBERT VON WOLFF, Shalco sales manager, will come to Cleveland as manager of the National Acme Shalco Division. FRANK SHALLENBERGER, president of Shalco, will continue as a consultant. ASHLEY HOLLINGSWORTH will be retained as chief engineer and NORMAN SWANSON as works manager in California. GEORGE V. HARRIS also will be available as a consultant on shell molding applications.

OAKITE PRODUCTS, INC., New York City, announces that T. A. (TED) ROHLFSEN has been appointed manager of the South Pacific Coast Division of the company. Mr. Rohlfsen succeeds J. C. LEONARD, who is retiring after thirty-five years of service. In his new position, Mr. Rohlfsen will direct the activities of fourteen technical service representatives in Southern California's industrial community.

SIEGLER CORPORATION'S Hufford Division, El Segundo, Calif., announces the completion of a new metallurgical laboratory, designed for the analysis of space-age metals.

Florida and Texas

MOORE INDUSTRIAL TOOLING CO., Orlando, Fla., has been appointed by the METALLURGICAL PRODUCTS DEPARTMENT of General Electric Co., Detroit, Mich., as an authorized Carboloy distributor in the central Florida area. The new distributor's address is 1110 West Pine St., Orlando.

JOSEPH T. RYERSON & SON, INC., Houston, Tex., announces the appointment of LOREN B. CLAY as sales manager. JAMES W. PROVAN was named manager of the general order and merchandise inventory department.

Illinois and Indiana

JOHN F. GAUDIAN has been appointed assistant sales manager of ARMSTRONG BROS. TOOL CO., Chicago, Ill. Mr. Gaudian has served as Chicago district sales manager since 1956 and will continue to supervise Chicago district sales in addition to his new duties.

DOLE VALVE CO., Morton Grove, Ill., announces the appointment of THOMAS B. CHACE to the newly created position of executive vice-president. The company also announced the appointment of FRANK H. BYRNE to vice-president—manufacturing.

KEITH A. HILL has been appointed chief engineer of new product development for the BESLY-WELLES CORPORATION, South Beloit, Ill.

HAYNES STELLITE CO., Kokomo, Ind., Division of Union Carbide Corporation, is now producing investment castings of Armco Steel Corporation's 17-4PH stainless steel. Parts will be marketed under the trademark "Haynes" alloy No. 474.

C. ROBERT STONE has been named chief production engineer of POTTER & BRUMFIELD DIVISION of American Machine & Foundry Co., Princeton, Ind.

Michigan

DETROIT BROACH & MACHINE CO. of Rochester, Mich., has licensed a worldwide manufacturing and sales organization to market its precision tools abroad. Association with the BIRMINGHAM SMALL ARMS TOOLS GROUP, which includes several companies forming one of Europe's largest manufacturers of broaching tools, machine tools, and cutting tools, will provide an enlarged network of overseas outlets for the firm's products. The group's worldwide sales organization will aid in introducing Detroit B.S.A. machine tools to manufacturers in more than forty nations throughout the world. Detroit Broach will continue to supply North and South American manufacturers with a complete line of broaches, broaching machines, and machine tools to specification under the new arrangement.

MICHIGAN TOOL CO., Detroit, Mich., has acquired the assets of GEAR GRINDING MACHINE CO. relating to gear grinding machines and processes, and has established a new Gear Grinding Machines Division with headquarters at 7171 E. McNichols Road, Detroit. The new Michigan Tool division will be responsible for engineering, manufacturing, service, and sales of gear grinding equipment.

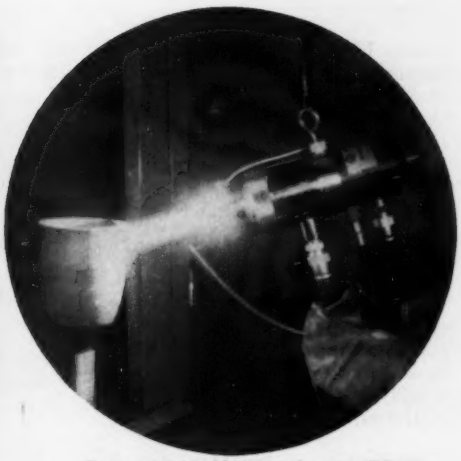
AMERICAN-STANDARD INDUSTRIAL DIVISION, Detroit, Mich., announces that ALBERT O'B. ANDREWS has been appointed president of the division. Mr. Andrews succeeds JOHN W. BRENNAN, who will engage in the engineering and development of the corporation's air-conditioning and related product lines, with particular emphasis on expansion in the overseas markets served by American-Standard.

UDYLITE CORPORATION, Detroit, Mich., announces that W. JOSEPH CLUFF retired as president of Frederic B. Stevens, Inc. He will continue as a consultant to Stevens and as a member of the board of directors of the Udylite Corporation. Mr. Cluff will be succeeded by CLYDE H. REEME, president of the Udylite Corporation, of which Stevens is a subsidiary.

PENINSULAR STEEL CO., Detroit, Mich., announces the appointment of ALTON L. WHEELER as manager of sales. Mr. Wheeler will direct the sales activities of all nine steel service centers of the company. This position was formerly held by WESLEY A. KURTZ, who is now vice-president of customer relations.

AC SPARK PLUG, the electronics division of General Motors Corpo-

NOW— PLASMA FLAME SPRAY IN YOUR OWN PLANT



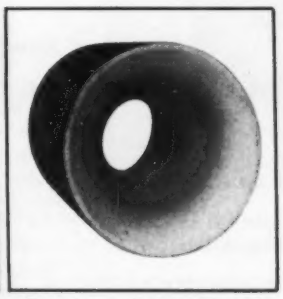
Flame spraying hi-temperature crucible

Apply coatings of high melting point materials with the METCO Plasma Flame Spray Gun...10,000°–15,000°F. A few: niobium carbide–tantalum carbide–thorium oxide–tungsten–zirconium boride

Now any material that can be melted without decomposing can be sprayed. Despite high melting temperature, object sprayed stays cool.

High fluidity of particles and high velocity of impingement bond particles together to produce high density coatings semi-fused to work surfaces. Absence of air eliminates oxidation.

Spraying tungsten on brass mandrel



Tungsten coated graphite part

Plasma Flame — how it works

The METCO Plasma Flame Spray Gun produces an arc contained in a water-cooled nozzle. An inert gas, blown through and around the arc, is "excited" to energy states having temperatures approaching 30,000°F. This Plasma "Flame" is used for melting and spraying any desired material.

Metco Type MB Plasma Flame Spray Gun

Here is a valuable new tool for the metalworking research department or production line. The METCO Plasma Flame Spray Gun operates on inexpensive inert gases, with high electrical power conversion efficiency and long component life. Continuous hot gas streams, as hot as 30,000°F., with accurate control of temperature, can be generated for costs of ⅓ to ½ those of oxygen-fuel gas equipment for equivalent heat output.

Other advantages include push-button operation, extremely simple training of personnel, elimination of flash-back and explosion problems.

Materials that can be sprayed

Specifically, a wide range of metals and their oxides, carbides, borides, and refractories have been sprayed with the standard apparatus on various shaped objects and mandrels. Coating densities are easily controlled and up to 98% of theoretical can be obtained. Lowered oxide contents, with improved bond and tensile strengths are additional advantages.

The METCO Plasma Flame Gun is the latest development in flame-spraying equipment by METCO. Write today for free bulletins describing the various flame spraying processes and the Plasma Flame Spray Gun.

Metallizing Engineering Co., Inc.

Flame Spray Equipment and Supplies
Westbury, Long Island, N. Y. • Cable: METCO
Telephone: EDgewood 4-1300
In Great Britain: METALLIZING EQUIPMENT CO. LTD.
Chobham-Near-Woking, England

Metallizing Engineering Co., Inc.
1131 Prospect Ave., Westbury, L. I., New York

Please send me free bulletin on the Metco Plasma Flame Spray Gun.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

For more data, circle this page number on inquiry card

ration, Flint, Mich., announces the promotion of CLIFFORD L. JOHNSON of AC Spark Plug Division to manufacturing manager of Hyatt Bearings Division, Harrison, N. J. Selection of JAMES L. ELLIOTT to succeed Mr. Johnson as director of production engineering at AC in Flint was also announced.

DANA CORPORATION, Toledo, Ohio, has created a new division to carry on the manufacture of Rzeppa constant-velocity universal joints. To be known as the CON-VEL DIVISION, it will remain in its present location in Detroit, Mich.

RIVETT INC., Boston, Mass., has appointed KERNS-MORRELL CO., 9140 Charlevoix Ave., Detroit, Mich., as exclusive distributor in the Detroit area for Rivett air and hydraulic valves, cylinders, and power units.

RICHARD P. VILLWOCK has been appointed research engineer of MICHIGAN ABRASIVE CO., Detroit, Mich.

ROTO-FINISH CO., Kalamazoo, Mich., announced the appointment of JOHN R. STROM as chemist and process engineer for the company.

DONALD T. WALKER has been named sales manager for COGSDILL TOOL PRODUCTS, INC., Oak Park, Mich.

New England

TORRINGTON MFG. CO., Torrington, Conn., announces that EDWARD E. FRANKS, JR., was appointed district sales manager in Chicago for the Machine Division of the company. EDWARD KEATING and ARTHUR FORTIN, under Mr. Franks' direction, will continue to cover Illinois, Indiana, Wisconsin, and part of Minnesota from Torrington Co.'s new, enlarged quarters at 6034 N. Cicero Ave., Chicago. This office will also include sales and engineering services for the fans, blower wheels, impeller units, and special blowers produced by the company's Air Impeller Division.

VEEDER-ROOT INC., Hartford, Conn., announces that ARTHUR E. KALLINICH, vice-president in charge of catalogue sales, will be vice-president in charge of new products and new businesses. Another Veeder-Root subsidiary, the HOLO-KROME CORPORATION, expanded its research and plant facilities in West Hartford, Conn., and completed manufacturing operations in Dundee, Scotland, for the marketing of a complete line of socket screw products overseas.

HARLAN J. HAUSER has been appointed manager of field sales for FARREL-BIRMINGHAM CO., INC., Ansonia, Conn., to succeed D. WHEELER CLARK. He has also been appointed to the company's management committee and has been transferred to the general offices in Ansonia.

WAYNE D. JOHNSON has been appointed assistant sales manager for NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn.

NORTON CO., Worcester, Mass., announces that ROBERT CUSHMAN has been appointed general sales manager of the company's Abrasive Division. W. ALEX MCCUNE succeeds Mr. Cushman as sales manager of grinding wheels. HARLAN T. PIERPONT has been appointed sales manager of abrasives, succeeding GEORGE A. PARK, who retired after a Norton career of fifty years. WILLIAM A. RUSSELL, formerly Detroit district manager, returns to the Worcester, Mass., office to assume Mr. McCune's post as manager of field sales, grinding wheels. DAVID H. PAUL has been named district manager at Detroit. Mr. Cushman has been with Norton for fifteen years. The company also announces the change of the corporate name of Norton Behr-Manning Overseas Inc. to Norton International Inc.

Robert Cushman, general sales manager, Abrasive Division, Norton Co.

BARRY CONTROLS, INC., Watertown, Mass., has announced its promotion of two executives. A. S. "MIKE" CHIVERS was promoted to the newly created post of manager of the Watertown Division. RUSSELL LOWE is promoted to manager of the Western Division, Burbank, Calif.

WOODROW TICHY has been elected a vice-president of the UNITED-GREENFIELD CORPORATION, Greenfield, Mass. In addition to his new corporate duties, Mr. Tichy will continue as general manager of the Whitman & Barnes Division, Plymouth, Mich.

GEORGE H. LOCKWOOD has been appointed manager of development and research for the HEALD MACHINE CO., Worcester, Mass.

WILLIAM T. KEATING has been named Boston area sales representative for ARMSTRONG BROS. TOOL CO., Chicago, Ill.

PAUL W. KNAPP was appointed sales engineer, carbide division, in the Boston area for FIRTH STERLING, INC., Pittsburgh, Pa.

BROWN & SHARPE MFG. CO., Providence, R. I., announces the appointment of JOHN F. HINES as sales manager of its Cutting Tool Division. RICHARD IRVING WHITE has been appointed to replace WILLIAM YATES, former B & S cutting tool engineer in the New England and upper New York State area.

New York and New Jersey

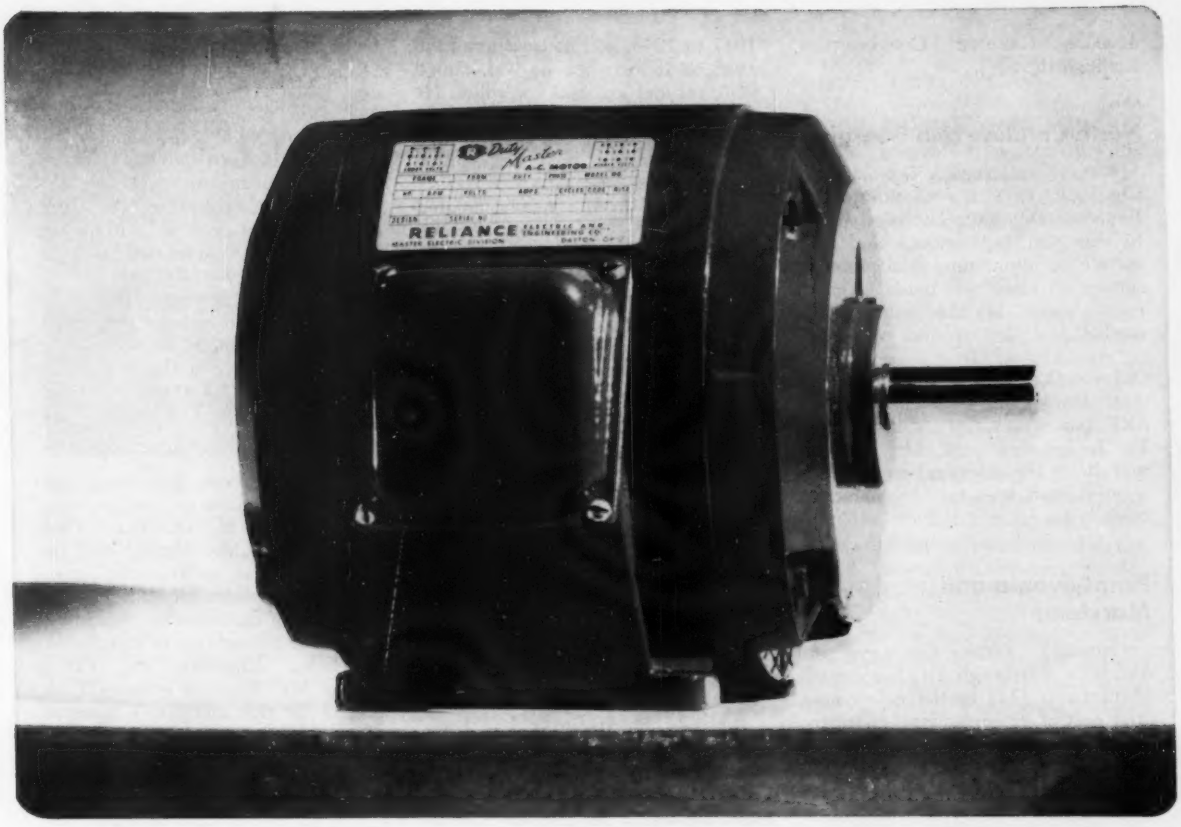
J. H. WILLIAMS & CO., Buffalo, N. Y., subsidiary of United-Greenfield Corporation, announces that JOHN F. SCHLEIFER has been promoted to superintendent of finishing. Mr. Schleifer is replacing MILTON P. BRADLEY, who has been transferred to United-Greenfield's Whitman & Barnes Division in Plymouth, Mich., as factory manager.

ROBERT E. WHITE was appointed eastern district sales manager of ARMSTRONG BROS. TOOL CO., Chicago, Ill., and will make his headquarters at the company's New York City office.

SIDNEY WADE has been appointed vice-president—distributor products of LINDE COMPANY, division of Union Carbide Corporation, New York City.

ROLAND H. WILSON has been appointed assistant works manager of RIVERSIDE METAL WORKS, Riverside-Alloy Metal Division, H. K. Porter Co., Inc., Riverside, N. J.

JACK H. POWERS has been named supervisor of metallography at



DUTY MASTER

a brand new a-c. motor

Product of Reliance Electric and Engineering Company and its Master Electric Division, Duty Master's new design gives users better protection from the inside out, simplified lubrication, better response and improved all around performance. The Duty Master line, from protected open, to totally enclosed, explosion-proof, 1 to 250 hp., is ready for delivery *NOW*.

Duty Master's insulation, by means of a series of multiple dips and bakes in thermosetting varnish plus final protection in finishing enamel, makes it resistant to water, acid, dirt and other contaminating elements . . . adds years to motor life.

"Metermatic" lubrication regulates flow of grease to the bearing—provides automatic grease relief. No danger of over-or under-lubrication . . . no maintenance headaches.

Duty Master's low inertia rotor has faster response in starting, stopping and reversing. This, plus better ventilation and increased accelerating torques, permits frequent starts and stops without over-heating.

Duty Master's new design proves conclusively that all a-c. motors are *not* alike . . . that this new motor gives users the best value in industry today.

Call your Reliance Sales Engineer or distributor—listed in the Yellow Pages—for the complete story, or write for Bulletin No. B-2106, Reliance Electric and Engineering Company, 24701 Euclid Avenue, Cleveland 17, Ohio.

B-1656

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 311A CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributors in Principal Cities

MASTER REEVES R

ADAMAS CARBIDE CORPORATION, Kenilworth, N. J.

North Carolina and Georgia

JOSEPH T. RYERSON & SON, INC., Charlotte, N. C., has announced that Reynolds aluminum has been added to the company's stocks and that service on aluminum, in addition to service on steel, was being given to metal users in the southeastern market.

JOHN O. CUSHING was appointed district manager, Atlanta, Ga., for SKF INDUSTRIES, INC., Philadelphia, Pa. In his new post, Mr. Cushing will direct the sales and engineering services' activities for the manufacturer in its Atlanta district.

Pennsylvania and Maryland

CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa., has named MAURICE J. DAY to the newly created post of vice-president—commercial in an expansion of its sales organization. Mr. Day will have full responsibility for sales management. GEORGE W. STAMM, vice-president of sales, continues in that position. WALTER E. GREGG succeeds Mr. Day as head of the Technology Department with the title of director of technology. He also continues in his present position with Crucible as director—Technical Development Division.

LANDIS MACHINE CO., Waynesboro, Pa., announces that LESLIE M. HESS has been elected vice-president and assistant general manager. He served as assistant treasurer from 1947 to 1948, and as treasurer from 1948 to 1958, when he was named treasurer and assistant controller. He has also served on the board of directors since 1956. He is succeeded by H. L. STECK, who was named controller-treasurer. E. C. HANNA was elected to the newly created post of director of engineering. GEORGE W. LYMAN succeeds Mr. Hanna as chief research engineer.

NICE BALL BEARING CO., Philadelphia, Pa., a division of Channing Corporation, has announced two promotions. THOMAS E. SPENCE becomes vice-president in charge of engineering. F. RUSSELL SMITH becomes chief engineer.

BILGRAM GEAR & MACHINE WORKS, Philadelphia, Pa., has announced the appointment of ADRIAN MARMOR as president and general manager. JOHN MAYWHORT, former Bilgram head, has disposed of his interest in the company and retired after fifty-nine years of service.

RICHARD P. SIMMONS has been named manager of quality control by LATROBE STEEL CO., Latrobe, Pa. Mr. Simmons will organize, coordinate, and direct the company's newly organized quality-control department.

USI ROBODYNE DIVISION of U. S. Industries, Inc., Silver Spring, Md., announces the appointment of S. S. PODNOS as general manager of the division.

Ohio

HANNIFIN CO., Division of Parker-Hannifin Corporation, Cleveland, Ohio, announced the appointment of O. J. MAHA as president and general manager. Mr. Maha succeeds ELLWOOD G. PETERSON, who will continue as a vice-president and director of Parker-Hannifin Corporation, specializing in corporate development. Establishment of three major product groups within the Hannifin Co. Division, each with its own manager, was also announced. H. H. ADAMS, Hannifin vice-president, was named to head the Power Cylinder Division, M. E. LAWRENCE becomes manager of the Machinery Division, and Z. J. LANSKY was made manager of the Air Valve and Crown Division.

E. W. SHUSTER has been appointed coordinator of foreign business for the E. W. BLISS CO., Canton, Ohio. Mr. Shuster will be responsible for coordinating company-wide policy for all foreign operations of the company, including manufacturing subsidiary companies at Derby, England, and Paris, France. Mr. Shuster's office will be located in the company's general offices at Canton.

FAWICK CORPORATION, Cleveland, Ohio, has established a new Hydraulic-Electronic Division. RAY G. HOLT has been named manager of the division. OSCAR H. BANKER continues as director of research and development of the new Fawick division. The Fawick Hydraulic-Electronic Division will have main offices, laboratory and production facilities at 9919 Clinton Road, Cleveland 11.

SIMONDS - WORDEN - WHITE CO., Dayton, Ohio, has announced the start of a one-third million dollar program to expand manufacturing facilities of its grinding wheel division. The new facilities, to be completed by December, 1959, will double production to meet the increasing market demands.

FERRY CAP & SET SCREW CO., Cleveland, Ohio, announced that HAROLD D. NORTH, JR., has been elected president of the company. Mr. North succeeds C. N. LANSING, JR., who resigned in June. JAMES M. KILLPACK will continue as Ferry board chairman. Elected new directors of the company were Mr. North, CARL C. CLAYTON, and JOHN D. WILLIAMS.

DONALD M. PATTISON has been elected president of HENRY P. BOGGIS & Co., Cleveland, Ohio.

(Left) Leslie M. Hess, vice-president and assistant general manager, and (right) E. C. Hanna, director of engineering, Landis Machine Co.

Lockwood Oliver, Jr., sales manager, Bardons & Oliver, Inc.

BARDONS & OLIVER, INC., Cleveland, Ohio, announces that LOCKWOOD OLIVER, JR., has been appointed sales manager. He succeeds EDWIN F. HUGE, a 53-year veteran with the company, who has retired from his position as vice-president in charge of sales. Mr. Huge will continue as a director. Mr. Oliver was New England sales representative and assistant sales manager before the appointment.

WALTER K. BAILEY, president of Warner & Swasey Co., Cleveland, Ohio, has been named a member of the board of directors of OSBORN MFG. CO., that city. Mr. Bailey is a director of the Warner & Swasey Co., as well as of a number of other firms. He is board chairman of Warner Swasey Asquith, Ltd., Warner & Swasey's English affiliate.

Walter K. Bailey, member of the board of directors, Osborn Mfg. Co.

The former PEERLESS ELECTRIC CO. of Warren, Ohio, became PEERLESS ELECTRIC DIVISION, the fourteenth division of H. K. Porter Co., Inc. Porter plans further expansion of Peerless Electric Division into the manufacture of other air moving equipment and electric motors requiring special design and manufacture.

LOUIS POLK, JR., has been named assistant vice-president and manager of the Gaging and Automation Systems Divisions, including the service and repair depots located in major industrial areas, of the SHEFFIELD CORPORATION, Dayton, Ohio, a subsidiary of the Bendix Aviation Corporation.

ROBERT S. BOLLIN has been appointed as chief engineer of TOLEDO PIPE THREADING MACHINE CO., Toledo, Ohio. In his new capacity, Mr. Bollin will carry on the program of redesigning, modernizing, and broadening the company's line of hand and power pipe tools.

TIMKEN ROLLER BEARING CO., Canton, Ohio, announces two promotions. ROSS RUSSELL has been named manager of industrial engineering at the company. Succeeding Mr. Russell as division industrial engineer of the Steel & Tube Division is TARZAN MONDA.

DARWIN & MILNER, INC., Cleveland, Ohio, has moved into new quarters in that city. The new warehouse and office are at 2222 Lakeside Ave.

Wisconsin and Minnesota

DUMORE CO., Racine, Wis., has acquired MASTER MFG. CO., INC., of Hutchinson, Kan. Officers of the newly organized company are ROBERT HAMILTON, chairman of the board; GEORGE E. SHOUP, president; DON MORTON and HOWARD ANDERSON, vice-presidents; M. E. HAMILTON, secretary; MARION H. TOLAND, treasurer. Other key employes include WILLIAM A. LACKEY, plant manager; G. L. SOLLENBERGER, purchasing agent; GENE LAVIELLE, plant foreman; and NORVAL MESKIMEN, inspector.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., announces that RUSSELL A. HEDDEN has been appointed works manager of manufacturing, Industries Group, at Allis-Chalmers West Allis, Wis., works. He succeeds E. W. BONNESS, who has been named consultant to the director of manufacturing, Industries Group.

JAMES K. MCGINLEY has been appointed general sales manager of DURANT MFG. CO., Milwaukee, Wis. Mr. McGinley will direct Durant's thirty-three sales offices in the United States, as well as its nineteen foreign sales offices.

E. F. VILTER CO., Milwaukee, Wis., has sold its line of machine tool attachments to the ZIERDEN CO. of 3815 S. Kinnickinnic Ave., Milwaukee. The attachments are sold under the "Tru Hole" trademark.

MINNEAPOLIS-HONEYWELL REGULATOR CO., Minneapolis, Minn., has appointed FRANK P. KELLY manager of manufacturing operations for the Brown Instruments Division, Philadelphia, Pa. He succeeds FRANK M. REA, who has been assigned to Honeywell's Industrial Products Group as a consultant in industrial engineering, tooling, and subcontracting.

Canada and Mexico

PANGBORN CANADA, LTD., Toronto, Canada, has been incorporated to market the complete line of blast-cleaning and dust-control equipment and metal abrasives produced by PANGBORN CORPORATION, Hagerstown, Md. Pangborn Canada has offices at 38 Mattson Road, Toronto. The board of directors and officers of the new company include: THOMAS W. PANGBORN, chairman; JOHN C. PANGBORN; RALPH M. TRENT, president; LLOYD L. STOUFFER, vice-president; and HELEN R. FISHER, secretary. JOHN R. BELL is treasurer.

GARLOCK PACKING CO., Palmyra, N. Y., announced that formal negotiations to manufacture mechanical packings in Mexico City have been completed. GARLOCK DE MEXICO, the name of the new subsidiary, is the joint venture of Garlock and its Mexican distributor, Louis Mulas, sucs., S. A.

Europe

H. A. LAMPMANN has been appointed manager of European sales engineering for the E. W. BLISS CO.'s Rolling Mill and Mackintosh-Hemphill Divisions. In his new capacity, Mr. Lampmann will be primarily responsible for sales engineering, service, installation, and erection of

Bliss mills and allied equipment. With the exception of the Western Hemisphere, Japan, and Australia, he will cover all parts of the Free World. While he will make his headquarters at the Bliss plant at St. Ouen-sur-Seine, near Paris, Mr. Lampmann will help further the activities of Bliss-Henschel, West Germany.

GIDDINGS & LEWIS MACHINE TOOL CO., Fond du Lac, Wis., has acquired a substantial interest in a German firm, NASSOVIA WERKZEUGMASCHINENFABRIK G. M. B. H., located in Langen near Frankfurt am Main, Germany. The Nassovia plant comprises approximately 60,000 square feet and presently employs approximately 400 persons. The product line of Nassovia is die-sinking and profiling machines, transfer machines consisting of rotary-table chucking automatics, and spark erosion machines.

Obituary

FREDERICK W. MCINTYRE, SR., died on October 8 in Worcester, Mass., at the age of seventy-two. He retired as chairman of the board of the Reed-Prentice Corporation of Worcester in November, 1954, and became a resident of Bal Harbour, Fla., in 1956.

New Books

AMERICAN STANDARD — REAMERS. ASA B5.14-1959. 59 pages. 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $2.50.

The newly revised American Standard B5.14-1959 covers nomenclature, definitions, types, sizes, and tolerances for reamers. Following a comprehensive glossary of reamer terms, there are tables of tolerances and general dimensions for thirty-seven types of reamers. The principal revisions are in the areas of nomenclature and the addition of standards for a greatly extended series of high-speed-steel straight-shank reamers.

MINUTES OF THE SEVENTH ANNUAL ATOMIC ENERGY COMMISSION WELDING CONFERENCE. 253 pages; 8 by 10 1/2 inches; illustrated. Distributed by Office of Technical Services, Department of Commerce, Washington 25, D. C. Price, $2.50.

This book recounts the events of the Joint AEC-ASM Welding Forum World Metallurgical Conference held in Chicago on November 6-8, 1957. It presents a comprehensive report of committee discussions relative to the welding of 347 stainless steel and the welding problems encountered by the U. S. Atomic Energy Commission contractors.

Coming Event

NOVEMBER 2-6—Forty-First National Metal Exposition and Congress to be held at the International Amphitheatre, Chicago, Ill. It is under the management of the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Chester L. Wells, director.

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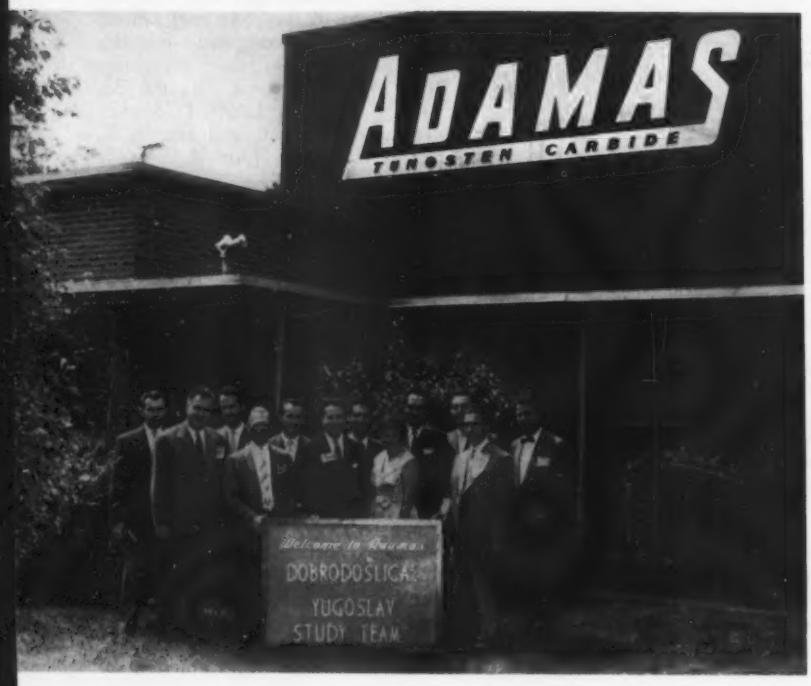
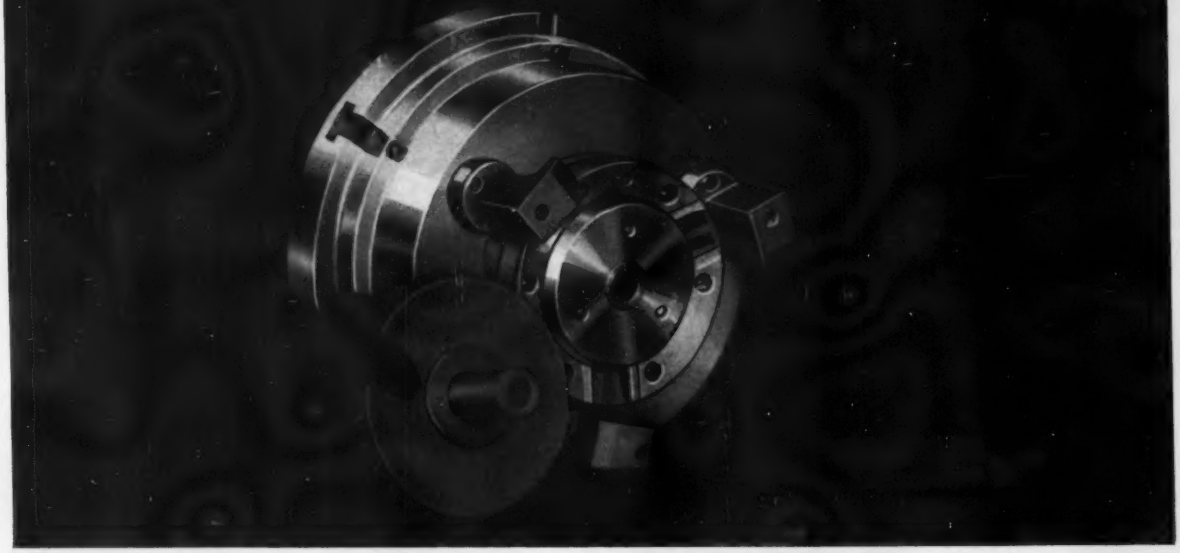
Conference on Taxation of Investments Abroad

Representative Hale Boggs, chairman of the Subcommittee on Foreign Trade Policy of the House Ways and Means Committee, will be a featured speaker at the Tax Institute symposium on "The Impact of Taxation on Management Responsibility for Investments and Operations Abroad," to be held in Washington at the Mayflower Hotel on December 3 and 4. H.R. 5, the "Foreign Investment Tax Act of 1959," was introduced by Representative Boggs, and is designed to encourage private American investment abroad by offering liberalized tax treatment.



DOBRODOSLICA (WELCOME)—Edward L. Dreyer (center), president of Adamas Carbide Corporation, Kenilworth, N. J., welcomes a study team of visiting Yugoslavian engineers. The group, eight men and one woman representing various Yugoslavian industries, visited Adamas as part of an extensive U. S. State Department-sponsored study of American metalworking plants and tool and die shops.

WORK-HOLDING BY WOODWORTH



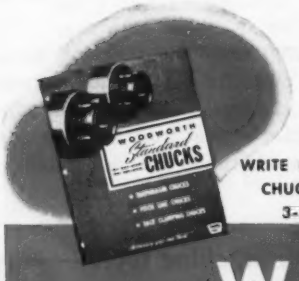
INTERNATIONAL HARVESTER CO. SPEEDS PRODUCTION WITH WOODWORTH'S "FINGER" CHUCK

R. C. PORTER

- **R. C. PORTER,** *Chief Mechanical Engineer of International Harvester's Farm Implement Division in East Moline, Illinois, apprised the performance of N. A. Woodworth's "FINGER" CHUCK as follows: "Formerly the chucking operation involved individual clamps which were tightened by socket head screws. This method of holding the part was not only slower, but each screw had to be adjusted exactly to the same degree to maintain quality and locate the gear accurately. Now, using Woodworth's air-operated "FINGER" CHUCK the gear is automatically clamped equally in a fraction of the time required in the previous method of holding."*

- **WOODWORTH'S SPECIAL AIR-OPERATED COMPENSATING "FINGER" CHUCK** (shown above) firmly and accurately positions nodular iron castings of beater shaft bevel gears for machining. Parts are automatically turned and faced in six operations on a #5 Gisholt turret lathe equipped with Lynn Hydraulic Drive: (1) Rough bore 1" in the shank for core drill; (2) core drill and turn; (3) finish bore and finish turn; (4) face boss and undercut; (5) face the end of the hub and chamfer I.D. and O.D.; (6) finish ream. The total stock removal is 3/32" on a side.

Using Woodworth's 13" drawbar operated "FINGER" CHUCK, International Harvester has cut loading time and INCREASED PRODUCTION FROM 4½ to 17 GEARS PER HOUR!



WRITE FOR CHUCK CATALOG 3-58

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for

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9-39-MR

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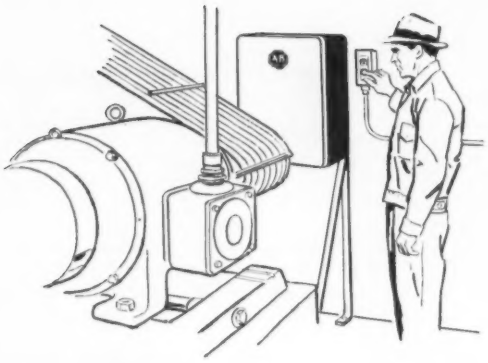

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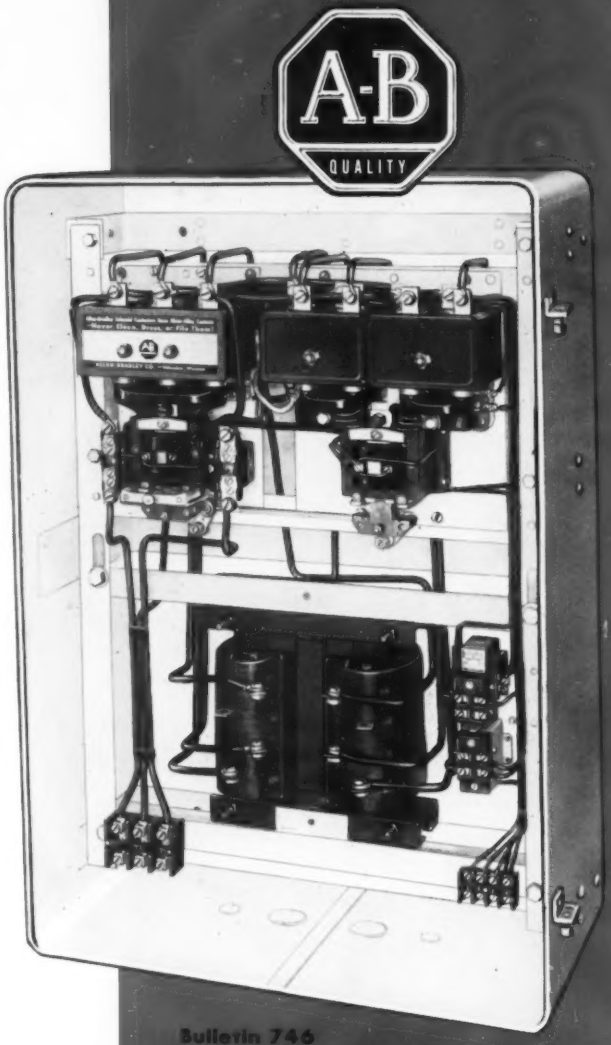
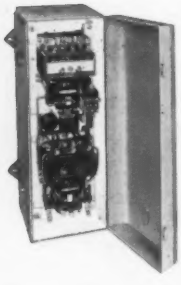


Bulletin 746

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

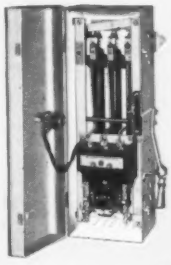


Bulletin 740

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



9-59-MR

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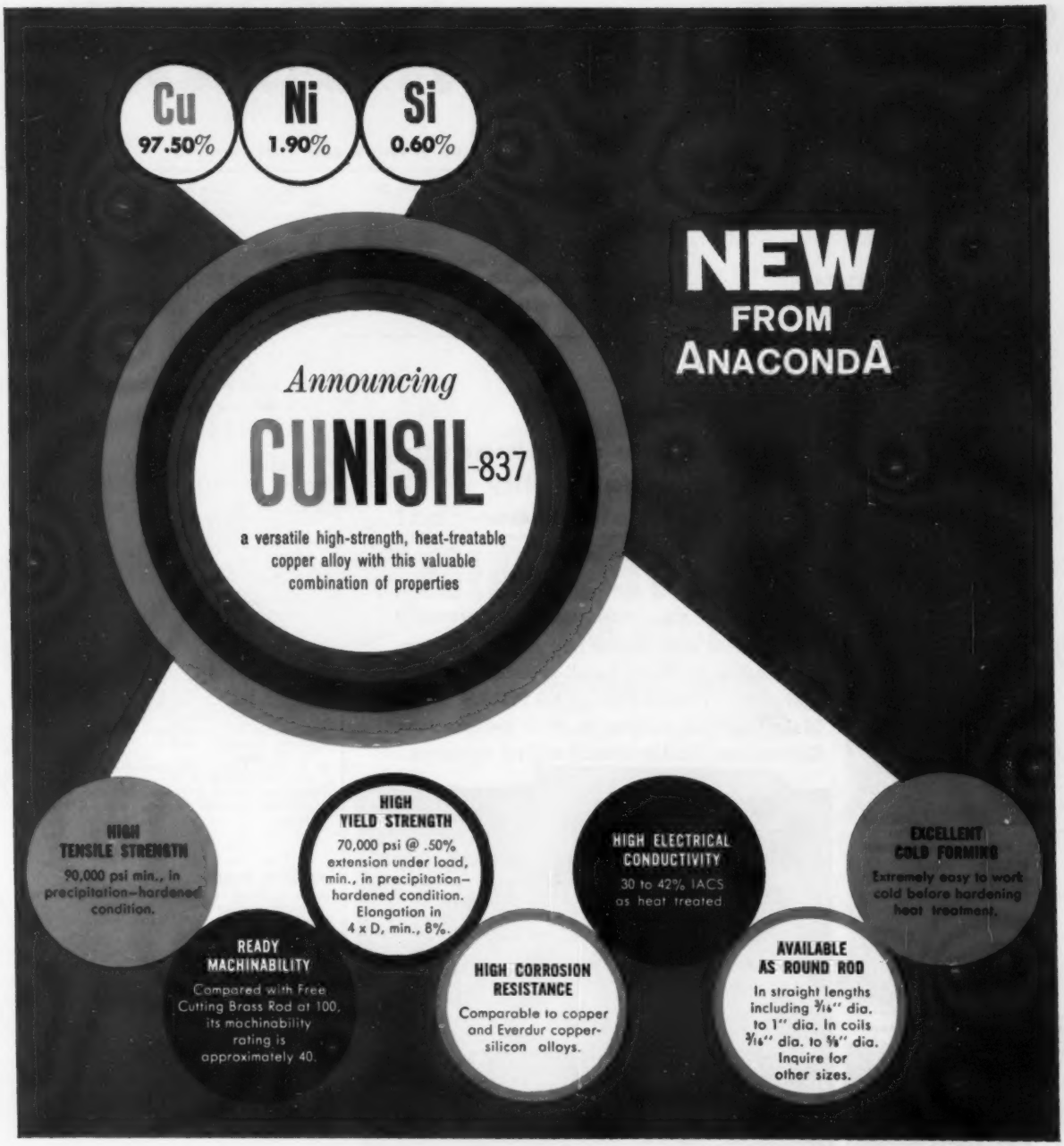
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a versatile high-strength, heat-treatable copper alloy with this valuable combination of properties
HIGH TENSILE STRENGTH
90,000 psi min., in precipitation–hardened condition.
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70,000 psi @ .50% extension under load, min., in precipitation–hardened condition. Elongation in 4 x D, min., 8%.
HIGH ELECTRICAL CONDUCTIVITY
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Compared with Free Cutting Brass Rod at 100, its machinability rating is approximately 40.
HIGH CORROSION RESISTANCE
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Prior to the hardening heat treatment, the alloy is brought to a proper condition for hardening by giving it a solution anneal at a much higher temperature and then a quenching from this temperature; at this stage the alloy is quite soft and in a condition for drastic cold-working operations. The hardening heat treatment consists of heating at a controlled temperature for a definite length of time to obtain the desired mechanical properties.

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Norton Co., 1 New Bond St., Worcester, Mass.

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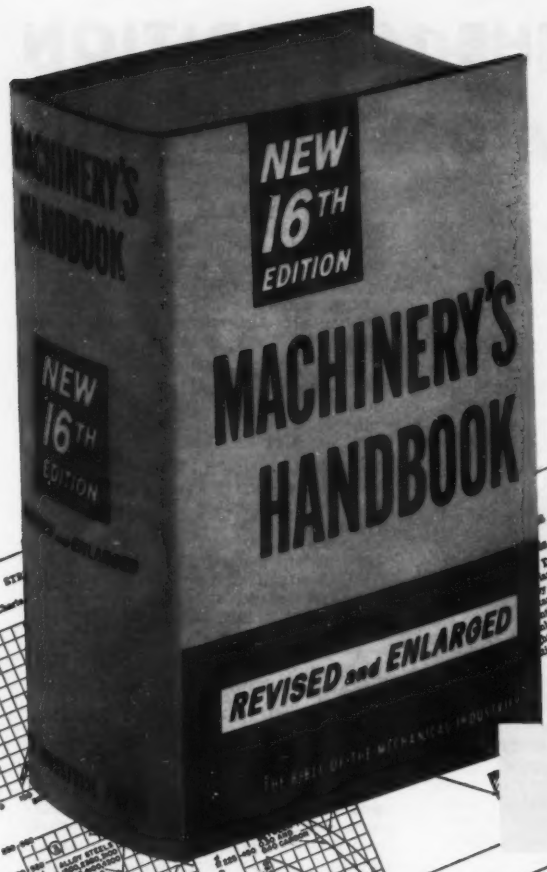

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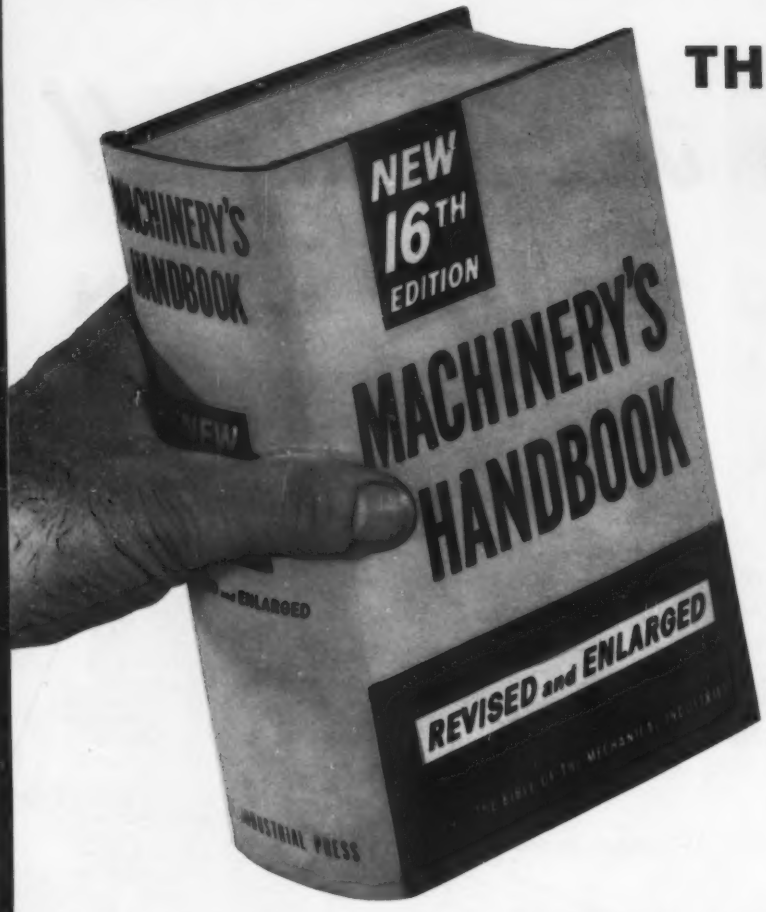
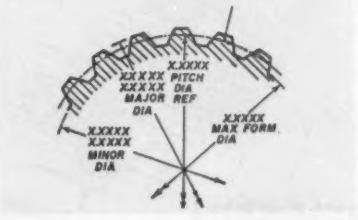


Since the publication of the 15th Edition of MACHINERY'S HANDBOOK, widespread time-saving and money-saving advances in metalworking technologies, techniques and standards have taken place. Here are just some of the topics that have been added to the 16th Edition to help you keep abreast of the changes and developments in the ever-progressing metalworking industry. Only a NEW Handbook can meet the needs of today's designing and metalworking jobs . . . help *you* move up to a better, more responsible position in your industry.

SCREW THREAD SYSTEMS. Probably the most widely used section in the Handbook, it has been completely revised to reflect the latest changes in screw thread standards. Contains dimensional data for all classes of Unified threads including the several new thread series recently added. The extensive tabular data and detailed discussion of Unified threads are useful to both the machinist and the designer. These tables present data for new Unified thread series and include hole sizes for tapping Unified threads based on the new minor diameter tolerances. Data are given for the manufacture and specification of Unified threads, the new Unified miniature screw threads, new dimensions for interference fit threads (studs), Acme screw threads, Stub Acme screw threads, and microscope threads. Complete diagrams for each of these threads show the disposition of allowances, tolerances and crest clearances.

GEARING. The subject of gearing has always been given careful attention in MACHINERY'S HANDBOOK. Advances in fine-pitch precision gearing called for the inclusion of this kind of detailed information: enlarged spur and helical gears from 7 teeth up, composite error inspection, checking pressures, indicator limits, angular position errors, angular backlash, and a complete tubular description of data for specification on drawings. . . . This is the first handbook to give the *exact* formula and tables of data for the selection of helical gear milling cutters in the production of milled gears for experimental and replacement purposes.

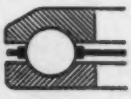


INVOLUTE SPLINES AND SERRATIONS. The widespread use of involute splines and serrations in place of straight splines has necessitated a new 43-page section giving complete design data, formulas, and dimensions in tabular form for the design, production, and specification of the various types of involute splines and serrations. As an aid to the draftsman, several pages are devoted exclusively to detailed drawing specifications for the various types of spline and serration fits. Tables of wire sizes and wire measurement data for involute splines and involute serrations are also included. The effect of spline errors on spline fits, error allowances and tolerances, and machining data pertaining to splines are also clearly explained and illustrated.

TWIST DRILLS. Included in this section are data on combined drills and countersinks, jobbers length millimeter drills, and other new data from the revised American Standard for twist drills.

PHYSICAL PROPERTIES OF STEELS. Heat-treated steels have been found to have the same tensile and yield strengths regardless of composition and alloying elements so long as they have been fully hardened to the same as-quenched hardness. Charts make it possible to determine expected tensile strength, reduction in area, yield points, and tempering temperature if the hardness of a particular steel is known. Strength data for a wide range of ferrous and non-ferrous metals are also given.

BALL, ROLLER, AND NEEDLE BEARINGS. This 72-page section gives standard description and dimensional data for all types of ball, roller and needle bearings. Besides dimensional and tolerance data for inch and metric bearings, there are data pertaining to shaft and housing fits, clamping and retaining methods, bearing life, radial and thrust load ratings, selection procedure for ball and roller bearings, equipment loads, bearing capacity, and bearing lubrication.



TAPS AND THREADING DIES. New designations, applicable to ground thread taps, have been added to this section which includes dimensions of all types of taps and dies. Recommended tap limits to achieve the various classes of fits in the Unified thread series are also included.

TAP DRILLS. Complete dimensional data have been included on drilled holes for Unified and Unified miniature internal threads, as well as for the old American Standard thread classes.

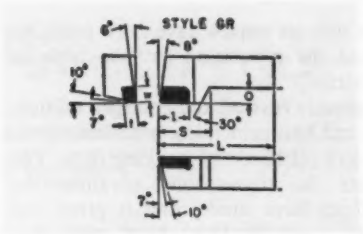
KNURLING AND KNURLING TOOLS. Complete data concerning the diametral pitch knurls recommended as providing good tracking by the American Standard are presented. Includes tolerances for work diameters before and after knurling.

CARBIDE BORING TOOLS. Standard data for solid and tipped carbide boring tools, as published in the latest American Standard, have been included because boring tools differ in many respects from other single-point cutting tools.

FLAT BELTS. The continuing popularity of flat belts in certain applications has been given consideration in 16 new pages, complete with diagrams for cutting, lacing and installation of these belts.

GIVES YOU THE LATEST DATA OTHER IMPORTANT SUBJECTS!

SINGLE-POINT CUTTING TOOLS. Added to this section are data on solid carbide inserts and their holders, with complete dimensions for each. These are the carbide cutting tools included in the latest American Standard.



SELF-TAPPING SCREWS. Data on drills and punched holes for self-tapping screws and the application of the various types of screws are presented.

TAPERS. Data on Morse stub taper shanks have been added to the already extensive taper-shank section of the Handbook.

SCREW THREAD INSERTS. Screw thread inserts including the self-tapping type are now widely used to achieve strong threads in soft materials, as well as for replacement of stripped threads.

TAPER PINS. To facilitate the machining of taper holes for taper pins a new chart has been provided showing drill sizes for step drilling prior to taper reaming.

GROOVED PINS. Dimensions of standard grooved pins have been given.

BOLTS, SCREWS, NUTS, WASHERS. Among the changes in this section are new American Standard dimensions for plain washers and toothed lock washers and clearances for box, open-end, and socket wrenches.

GRINDING, POLISHING, AND LAPPING. This new 54-page section provides the latest in available data, techniques, and process descriptions in connection with grinding wheels, wheel dressing, centerless-, surface-, cylindrical-, offhand- and portable-grinding. Tables of grinding troubles give recommendations for their correction. Descriptive data facilitate the selection of proper grinding wheels.

METAL JOINING, CUTTING AND SURFACING. This completely new 36-page section deals with soldering, brazing, hard facing, welding, flame cutting, arc-cutting, etc. In addition to detailed descriptions of each of these processes, convenient tables aid in the selection of the best process for the operation at hand. Explains brazing of high-speed steel tips to carbon steel shanks.

V-BELTS AND SHEAVES. The increasing use of V-belt drives is reflected in the new 17-page section dealing with such topics as: light-duty drives, belt cross-sections, sheave dimensions, horsepower ratings, multiple V-belts, V-belt installation, service factors, operating speeds, idlers, V-flat drives, double-angle V-belts, and selection procedure.

TRANSMISSION CHAINS. A section of 41 pages provides coverage of transmission roller chains and silent chains. Discussed are: sprockets, chain parts, keys, keyways, set-screws, center distance between sprockets, length of chain, cutting sprocket tooth form, sprocket materials, cutters for sprocket teeth, horsepower ratings, design procedure, chain designations and dimensions, drive ratios, chain selection, etc.

FLYWHEELS. Because the flywheel is so important as a source of energy for punching, shearing and other shop operations as well as a means of providing a uniform flow of energy in rotating engines, new data pertaining to the design of flywheels are given. This takes account of centrifugal stresses, combined stresses, and residual stresses. Of primary importance are the two up-to-date tables of safe speeds for flywheels in accordance with American Standard and insurance company requirements.

STRENGTH OF MATERIALS. The data given on the strength of materials, or mechanics of materials, take the guesswork out of determining the most economical size and shape of machine parts or structures to meet strength and deflection requirements. In addition to formulas and data that apply to straight beams and columns, new sections have been added, giving formulas and tables for curved beams such as are used in machine frames; pipe columns; round, rectangular, and square plates; cylinders subjected to internal and external pressure; tubes, and shells.

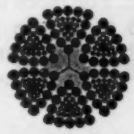
SHAFTS. Formulas and directly applicable tables for strength and horsepower capacity, as well as considerations of torsional and linear deflection for various conditions of loading, are given in detail. Included are formulas for critical speeds of rotating shafts, formulas for shafts of brittle materials, and data for the effect of keyways on shaft strength.

STANDARDS. Data and information from the latest American Standards have been included, wherever possible throughout the wide range of Handbook topics. Comparable data and information from a large number of British Standards have also been given to provide a reliable reference on British practice.

SPRINGS. The data for designing and winding springs have been supplemented by a new section giving a detailed description of the most widely used spring materials, their strengths, moduli of elasticity, service factors for various applications, endurance limits, and working stresses at elevated temperatures.

PLAIN BEARINGS. A complete section on the factors to be considered in the design and selection of plain bearings, as well as a step-by-step procedure utilizing simple charts and formulas, has been provided as a guide for the designer. In addition to complete tables of alloys for both solid and sintered bearings, information on wood bearings, plastic laminate bearings, rubber bearings and others is given and the procedure for babbitting bearings in the shop is explained in detail.

INVOLUTE FUNCTIONS. Involute functions of angles have been established as the most convenient means for solving certain problems in gear design and measurement. A complete set of involute functions from 14 to 58 degrees in increments of one minute and to as many as seven decimal places is provided.



WIRE ROPE. Some of the topics covered in this new 17-page section are: installation, safe working loads, factors of safety, sizes, simplified practice recommendations, drum and reel capacities, maintenance, lubrication, replacement.

The Use of Handbook Tables and Formulas

A Companion Book for Users of MACHINERY'S HANDBOOK which Shows You How to Get the Most out of Your Handbook.

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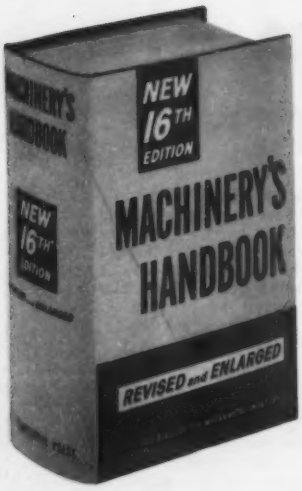

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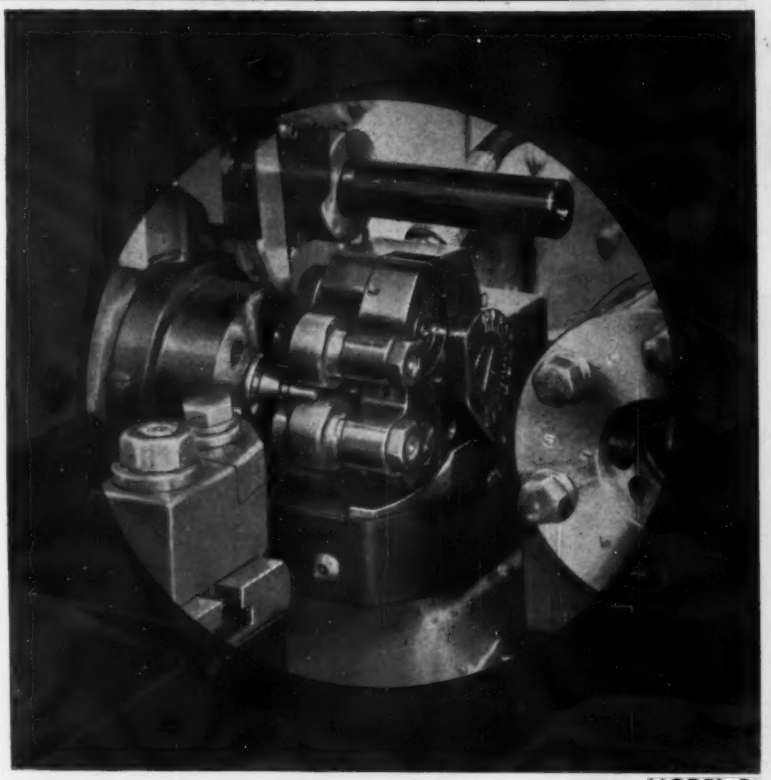

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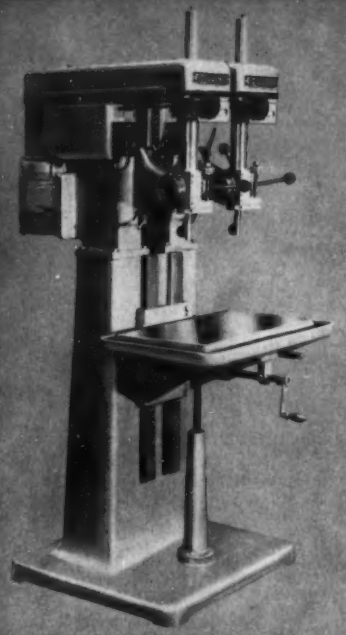

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Sensitive machine for small parts and components.

Infinite selection of speeds to 10,000 rpm

7" & 10" Overhang

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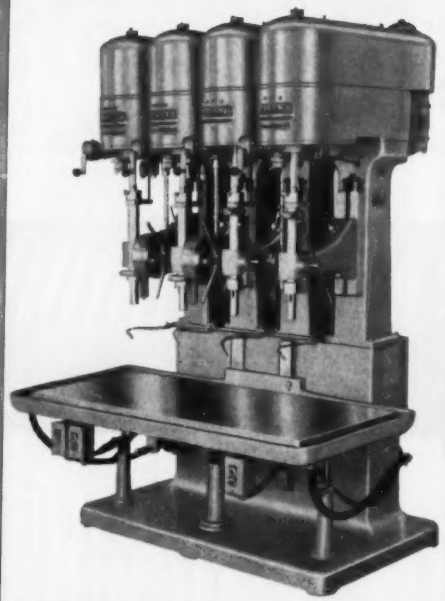

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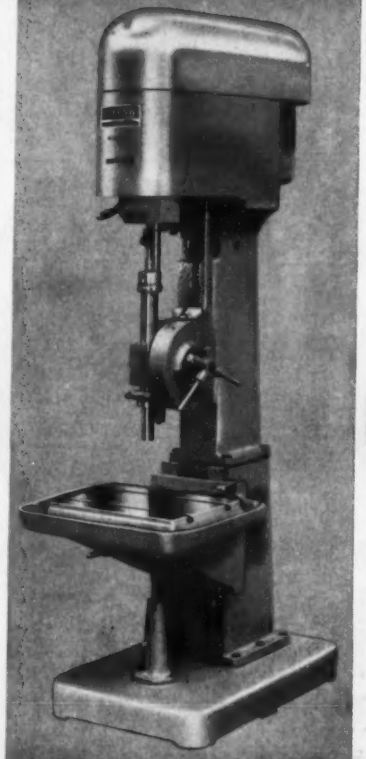

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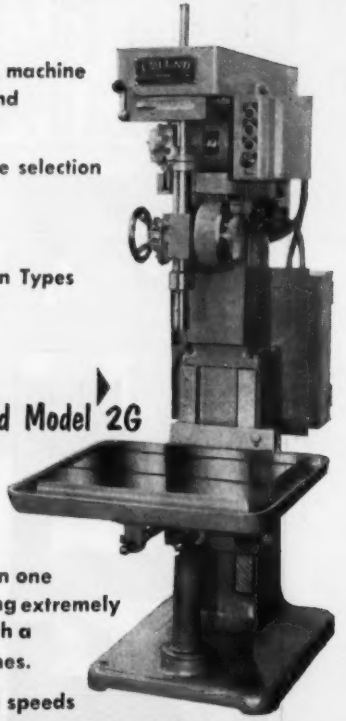

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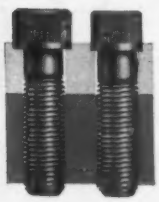

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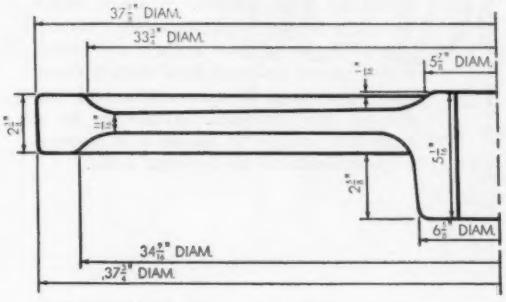
(Continued on page 246)

GEAR *installed in hoist mechanism of Koehring Company power shovel.*

EXCELLENT *response to induction hardening? Take a look!*



This gear now costs $35.24 less,

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"We are also very pleased with product machining properties, freedom from defects in the tooth area, and excellent response of the forging to heat treatment."

KOEHRING COMPANY, MILWAUKEE, WISCONSIN
manufacturers of construction equipment

Koehring Co. previously machined this gear from a cast gear blank. Today they machine it from an impression-die steel forging made on Bethlehem's unique Slick Mill. They save $29.24 in first cost, plus $6.00 in machining costs! (Turning, boring, facing, and hobbing teeth.)

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Bethlehem's Slick Mill saves the Koehring Company $35.24 *per gear.* How much can it save you?

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BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
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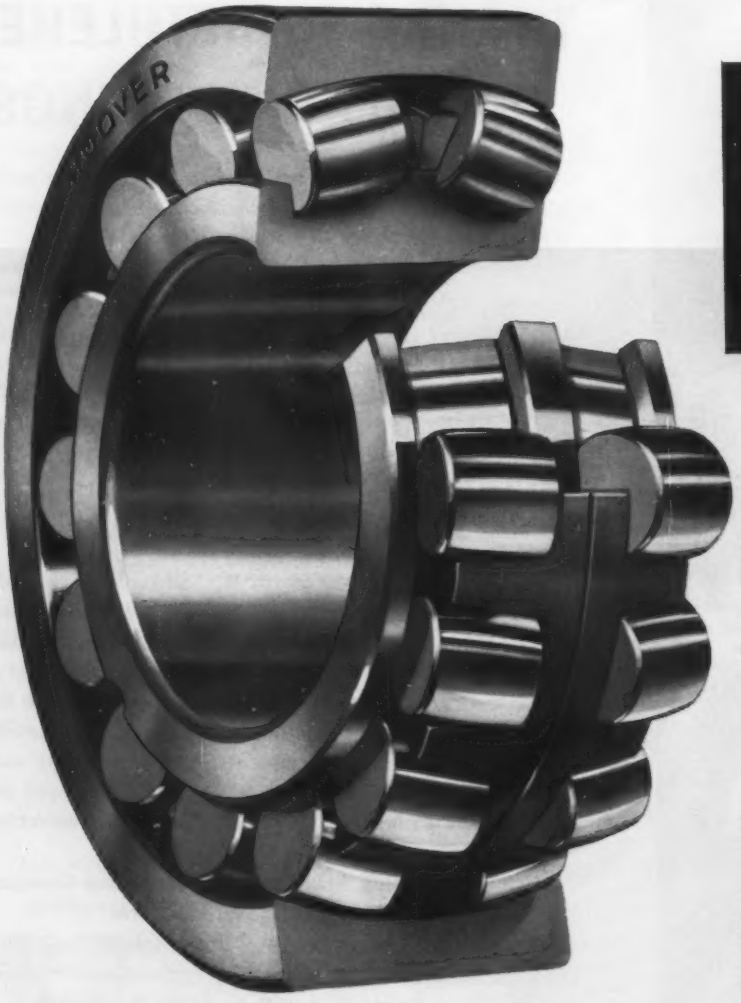
BETHLEHEM STEEL

NOTICE *the thin disc shape on this 395-lb gear blank. A cinch on the Slick Mill!*

BETHLEHEM STEEL

Now! *Hoover Quality*

HOOVER *super finish* RACEWAYS AND ROLLERS



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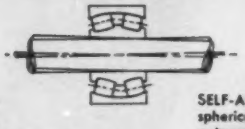
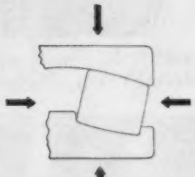
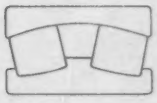
Complete Range of Series and Sizes



SELF-ALIGNING—Hoover spherical roller bearings automatically compensate for shaft misalignment in any direction, either initially or dynamically under load.



RADIAL OR THRUST LOADS—Double row of large-size rollers provides capacity for heavy radial and shock loads. High contact angle provides substantial thrust loads in either direction.



ACCURATE ROLLER GUIDANCE is assured by heavy center flange guide, asymmetrical roller design and heavy machined bronze, land-riding retainers.

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Depend on Hoover to set new high standards for roller bearing quality . . . *Hoover Quality!*

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Hoover enters the roller bearing field with complete lines of the most widely used of spherical and cylindrical types. Hoover roller bearings are accurately made of the finest of materials. They utilize the most successful of operating and design features. They assure you the best in roller bearing performance for a wide range of applications.

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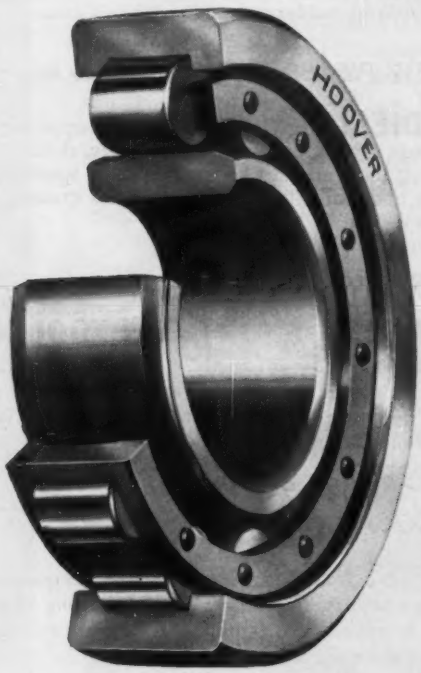
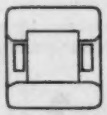
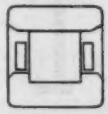
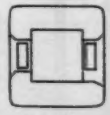


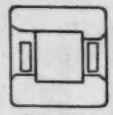
Hoover Quality cylindrical roller bearings are designed with crowned rollers that provide uniform load distribution for maximum radial load capacity and minimum friction. Because they are cool running, high speed operation under heavy radial loads is possible.

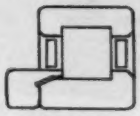
Rollers and raceways are *Super Finished* to mirror-like smoothness for quiet operation and long life. Retainers are machined solid bronze assuring strength and accurate roller guidance. Available in a complete range of series and sizes in the types pictured at right.


Type NU—Straight inner race


Type N—Straight outer race


Type NJ—Single flanged inner race


Type NF—Single flanged outer race


Type NH—Single flanged inner race with stabilizing ring

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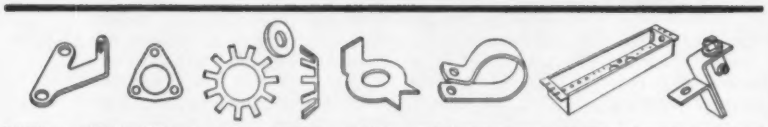

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Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
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Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
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Lucas Mch. Tool Div., New Britain Mch. Co., 12302 Kirby Ave., Cleveland 8, Ohio
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

BORING TOOLS
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Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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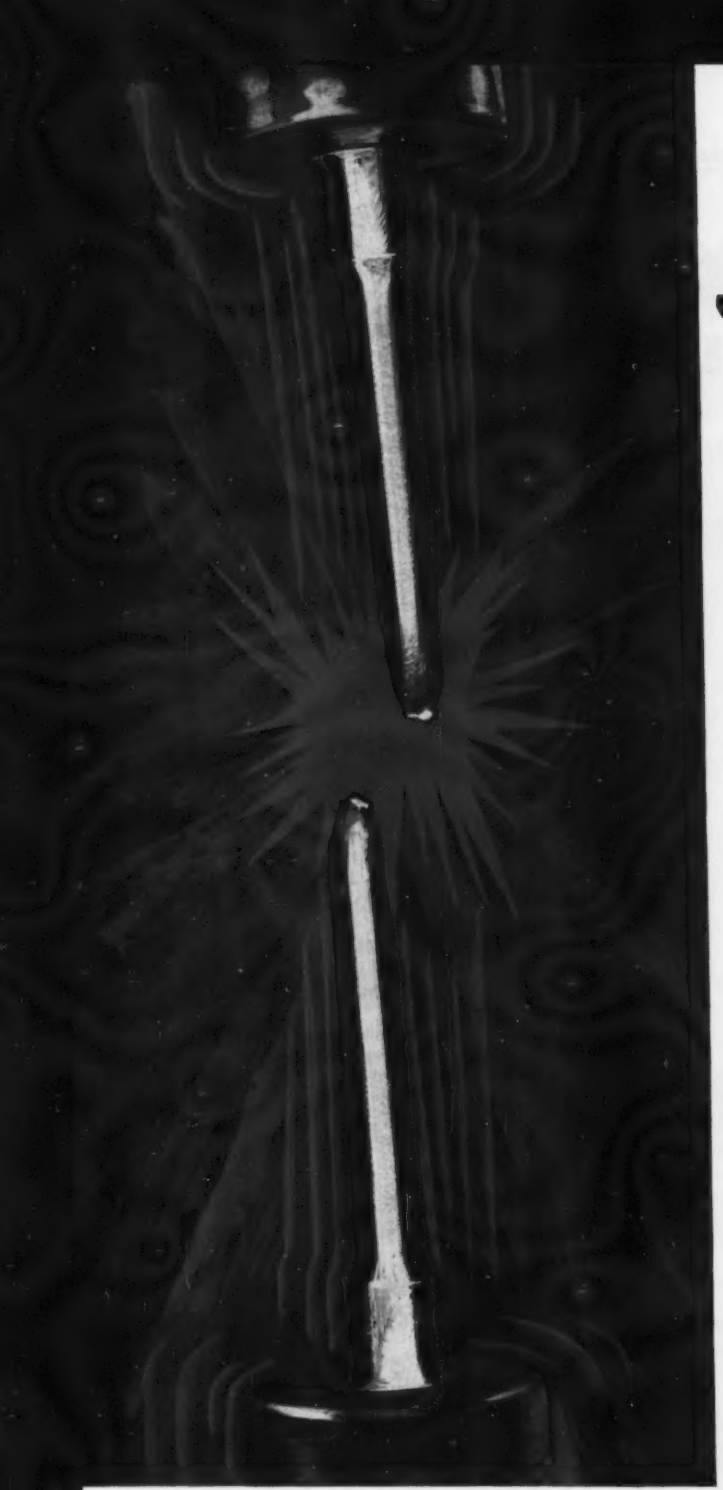
Cincinnati Shaper Co., P.O. Box 111, Cincinnati 11, Ohio
Cleveland Crane & Engrg. Co., Wickliffe, Ohio
Lodge & Shipley Co., Hamilton 1, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 93rd St. and S. Kenwood Ave., Chicago, Ill.

BRASS
American Brass Co., 25 Broadway, New York N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.



"How Jessop Stretches Specialty Steels"

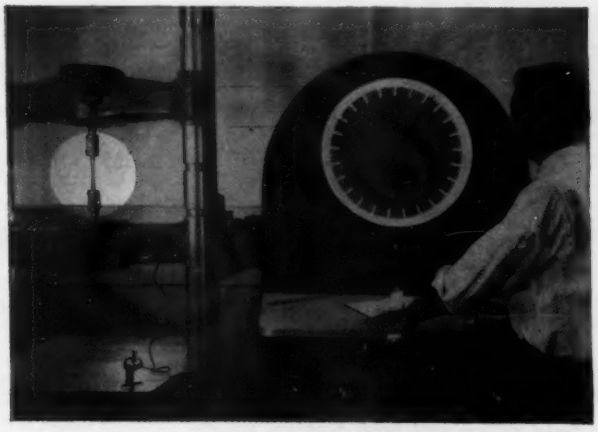
Robert Timko, Metallurgist

"At Jessop, tensile testing of specialty steels is carried out with far more than ordinary precision. It pays. It's one of the reasons our repeat business is so high.

"Based on a series of photographs, this drawing shows a specimen of type 304 annealed stainless steel bar at the climax of a tensile strength test. Moving apart, the heads of the tensile testing machine stretched the bar until it finally ruptured at 5500 psi above the spec."

In this Jessop metallurgical laboratory, top metallurgists using all types of modern testing equipment help us make certain you get *consistent* high quality in specialty steels. *Specify Jessop . . . and then relax.*

VMA 6788



Tensile testing machine in the Jessop metallurgical lab. Stretch, strain and then bang! The specimen of type 304 annealed stainless bar ruptured at 5500 psi above the spec. Tensile strength okay!

In the Jessop metallurgical lab, this tensile testing machine is one of many types of tools used to make certain you get *exactly* what you want in specialty steels.

Jessop Steel International Corporation
Steel Warehousing Corporation, Chicago
Green River Steel Corporation
Jessop Steel of Canada, Ltd.

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STEEL COMPANY
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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

BROACHING MACHINES, Internal
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

BROACHING MACHINES, Surface
Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE
American Brass Co., Waterbury 20, Conn.
Mueller Brass Co., Port Huron 35, Mich.

BRUSHES, Industrial, Tampico, Wire Wheel, Etc.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio.

BUFFERS
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

BULLDOZERS, Metalforming
Birdsboro, Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BURNISHING MACHINES
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Corbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Universal Engrg. Co., Frankenmuth, Mich.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools Machinists' Small Tools

Tool Steel Topics

BETHLEHEM STEEL

BEARCAT EMBOSSES INTRICATE GOLD

10k gold strikings for class rings no problem for this outstanding shock-resisting tool steel

Bearcat tool steel is performing brilliantly at The Metal Arts Co., Inc., Rochester, N. Y., where it is used in embossing 10k gold ring shanks and bezels for high school and college class rings. Bearcat was suggested by our local tool steel distributor, The Burke Steel Co., Inc., Rochester.

"Of course there are other grades which might be satisfactory," the Burke representative told them, "but what you are looking for is outstanding shock-resistance. Put Bearcat to work in this job and you'll never be sorry."

At last report, the dies were bearing out the propheey. Hardened to Rockwell C-58-59, and operating in drop hammers, they had turned out thousands of the intricate gold strikings, without any sinking or breaking.

Bearcat, our super grade of shock-resistant air-hardening tool steel, takes shock jobs in stride, and has superior wear-resistance. And because it's air-hardened, Bearcat minimizes quenching hazards and distortion in heat-treatment.

Next time you're looking for a really tough tool steel, team up with Bearcat. You'll be glad you did.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Stainless Is Tough On Tools

Many items formerly made of soft steel are now being made of stainless steel. The austenitic stainless steels (AISI 300 series) are popular because of their corrosion-resistance, plus their strength and oxidation-resistance at moderately high temperatures.

Whenever stainless parts are made with tools formerly used on soft steel, there is a marked decrease of production of parts per tool. For example, on a simple blanking operation on stainless steel, the production per grind on the punch and die usually is about one quarter of the production on soft steel.

Though it is rarely possible to change conditions so that the "normal" tool life can be realized when making stainless parts, some improvements can be made. For example, if the blanking tools were originally made of AISI W1 water-hardening or O1 oil-hardening tool steels, a change to D2 high-carbon, high-chromium tool steel is suggested. This change will improve the tool life from two to three times. Or if D2 high-carbon, high-chromium tool steel is already being used, it may be necessary to carburize, or to nitride, in order to improve the wear-resistance. Close attention must be paid to mechanical conditions, such as proper clearance between punch and die, proper penetration of the punch, and optimum grinding procedures in finishing the tools.

Because stainless is tough on tools, careful planning is necessary for good tool life.

Write for

BETHLEHEM TOOL STEEL LITERATURE

If you would like to have booklets on our tool steel grades, just check your choice below, and mail to Room 1042, Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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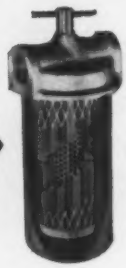
CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not Available.

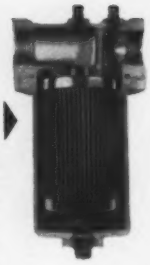


Synclinal LINE TYPE

CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
BY-PASS VALVE: Not available.
OPERATING PRESSURES: Up to 80 p.s.i.

Bonded SUMP TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1¼"—1½"—2"—and 2½".
CONNECTIONS: Coupling—"O" Ring—Male Nipple.
BY-PASS VALVE: Available with or without

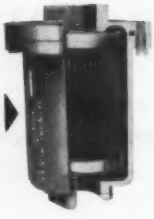


Bonded LINE TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1¼"—1½"—2" and 2½".
BY-PASS VALVE: Available with or without.
OPERATING PRESSURE: Up to 250 p.s.i.
OPERATING TEMPERATURES up to 300° F.

Tandem SUMP TYPE

CAPACITIES: 10—16—20—40—60—100—150 and 200 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.



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CAPACITIES: Up to 60 G.P.M.
PIPE SIZES: ¾"—1"—1¼" and 1½" (at both inlet and outlet).
BY-PASS VALVE: Available with or without

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Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

CAM CUTTING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

CAMERAS, High Speed
Wollensak Optical Co., Rochester 21, N. Y.

CAM MILLING AND GRINDING MACHINES
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Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS
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Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Rowbottom Machine Co., Waterbury, Conn.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65 St., Cleveland 2, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 781 Union Commerce Bldg., Cleveland 14, Ohio
Shenango Furnace Co., Dover, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Textile Machine Works, Reading, Penna.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Jessop Steel Co., Washington, Penna.

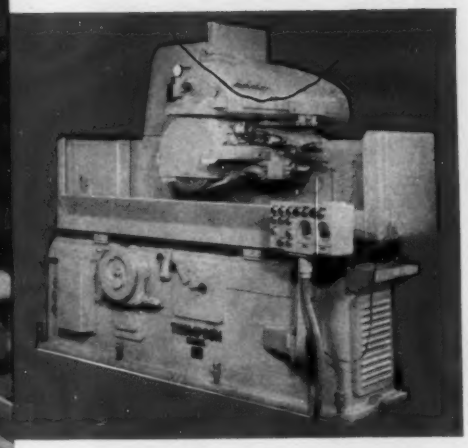
CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
DoALL Co., Des Plaines, Ill.

(Continued on page 252)

THE NEW THOMPSON PLUNGE-MATIC SURFACE GRINDER



COMPLETELY AUTOMATIC

With the new Plunge-Matic, Thompson now offers a plunge feed machine for those surface grinding jobs where the area to be ground is constantly covered by the grinding wheel width. Designed for fast production, the Plunge-Matic is completely automatic—including downfeed, wheel dressing and automatic compensation.

Shown above is one of four Plunge-Matics in use at the Disston Division, H. K. Porter Company, Inc., grinding high quality hand saws. The saws are held on tapered flux bars or magnetic shims and the wheel face is dressed straight with an automatic power operated wheel truing device. The four machines are equipped with a pre-selected variable downfeed arrangement which automatically decreases the downfeed rate as the contact area of the work increases. The wheel heads are also equipped with oscillating crossfeeds. Being completely automatic in their cycles, the four machines require but two operators who load and unload only.

Constant Accuracy is Assured by Hydra-Cool

All Thompson Plunge-Matics are made in various types and sizes to meet all job requirements. All machines of 40 inches and up in work length are equipped with the Hydra-Cool Hydraulic System*—the exclusive Thompson feature which eliminates all heat distortion throughout the machine.

* PAT. APPLIED FOR

The new Thompson Plunge-Matics are designed to grind contoured as well as flat surfaces with equal efficiency. The three drawings at right represent but three of many contour jobs which Thompson Plunge-Matics are now handling successfully.

SPECIFICATIONS	
GRINDERS:	Thompson Type C 12"x16"x-48" Plunge-Matics
WHEELHEAD:	40 HP
WHEEL:	20"x8"x12"
STOCK REMOVAL:	Approx. .010" from each side
PRODUCTION RATE:	60 saws every 50 minutes from 2 machines with one operator

Send for descriptive folder on this new Plunge-Matic surface grinder.

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"

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SPEED-BAND®
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CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
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New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
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Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio

CHUCKS, Air Operated
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

CHUCKS, Combination Universal-Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L.W. Chuck Co., Toledo 4, Ohio
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
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CHUCKS, Diaphragm
Woodworth, N. A. Co., 1300 E. Nine Mile Rd., Detroit 20, Mich.

CHUCKS, Drill, Key Type
Jacobs Mfg. Co., West Harford, Conn.

CHUCKS, Drill, Keyless
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N.Y.
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Full Floating
Gisholt Mch. Co., Madison 10, Wis.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.

CHUCKS, Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathe
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Gisholt Mch. Co., Madison 10, Wis.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

CHUCKS, Magnetic
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Hanchett Magna-Lock Corp., Big Rapids, Mich.
L-W Chuck Co., Toledo 4, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

CHUCKS, Power Operated
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Universal Three-Jaw
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
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(Continued on page 256)

SPECIALLY DESIGNED LATHE

grooves rotors for large steam turbines

Shown at work is one of three Farrel-Betts 60" heavy-duty lathes built for General Electric Company's Large Steam Turbine-Generator Department at Schenectady, N. Y. It was designed for both speed and accuracy in machining turbine rotor grooves of various depths from steel alloy forgings.

The rotors are grooved by front and rear tools in a plunge cut. The front tool takes out the center section of the chip so that the slot is cut to full width in one pass. The lathe takes cuts 2" wide at 220-sfpm speed and .028-ipm feed, resulting in a metal-removal rate of 168 cu. in. per minute.

A special electrical dimensioning system indicates the carriage position along the bed for accurate groove positioning. Replaceable hardened and ground steel ways of the square-lock type are used.

Bulletin 1216 will give you more complete information about the design and performance of Farrel-Betts heavy-duty lathes. Ask for a copy today.

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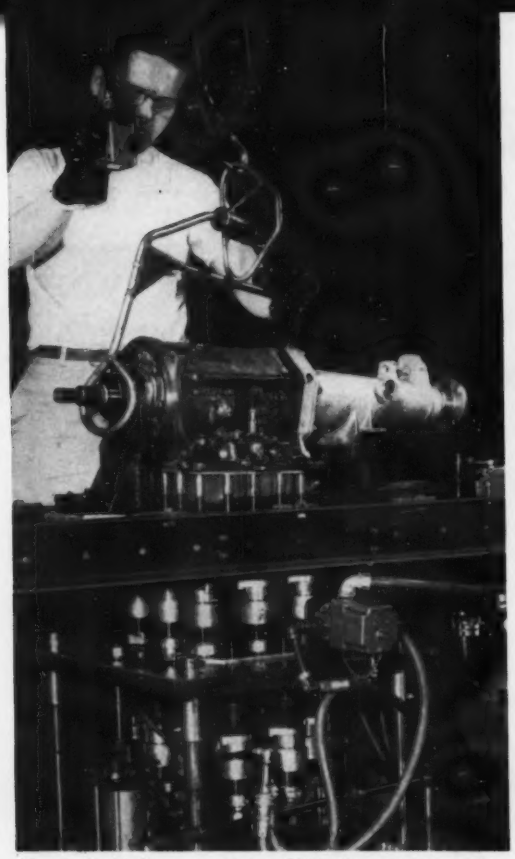
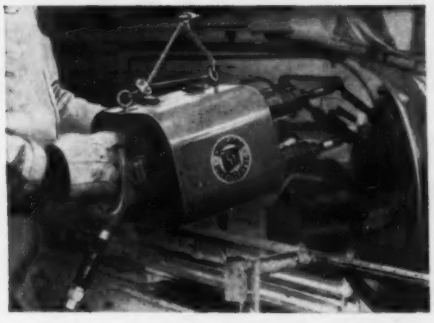


18-spindle Multi-runner drives 5/16" bolts on transmission oil pan assembly.

4-spindle Multi-runners make fast work of installing front motor mounts.



4-spindle Magnamatic Multi-runner sets cap screws on window regulator to uniform tightness, then releases instantly.

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Put CP Magnamatic Multi-runners in the hands of your assembly operators and every fastener—on every unit—will be run to the proper torque. You don't have to do "follow-up" tightening by hand. You can spot check instead of checking every unit. You can hold your quality while you cut your time.

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COMPOUNDS, Cuttings, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

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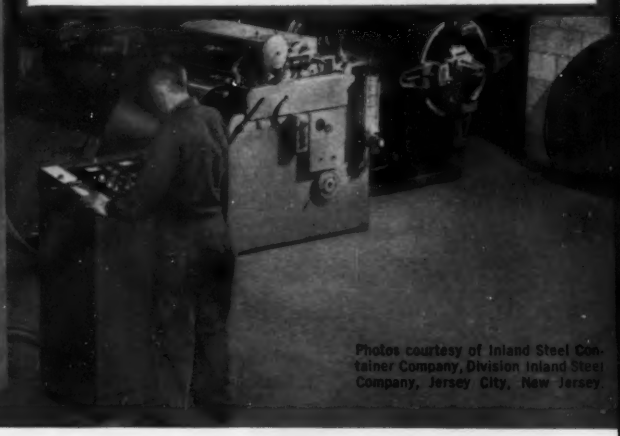

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Cleveland Crane & Engrg. Co., Wickliffe, Ohio.

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Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.

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Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill. (end mills).
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DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
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Vascoloy-Ramet Corp., Waukegan, Ill.
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Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
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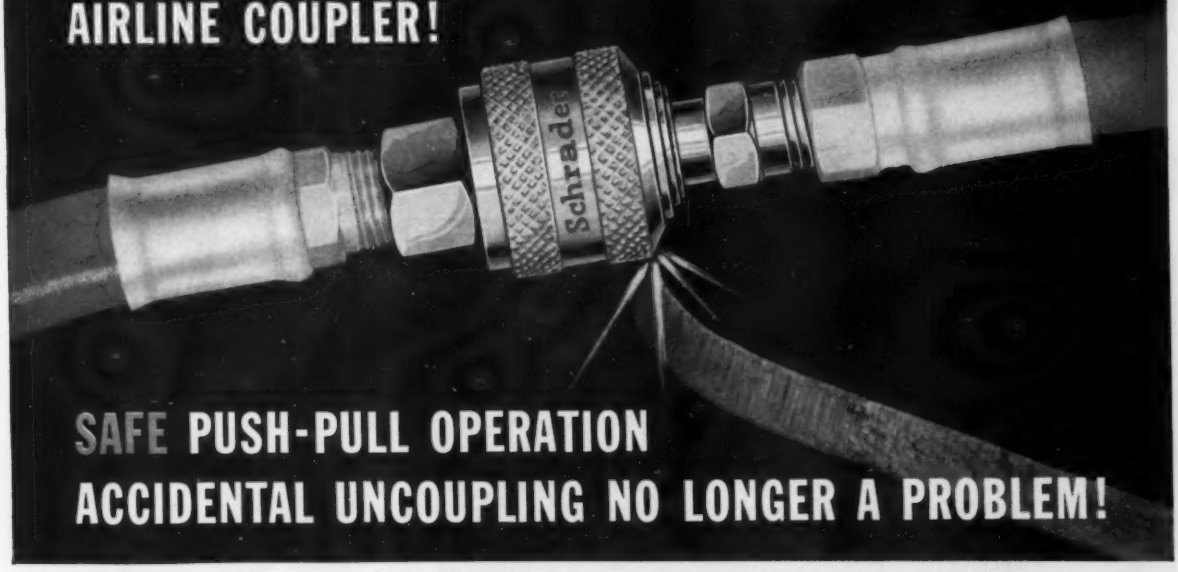

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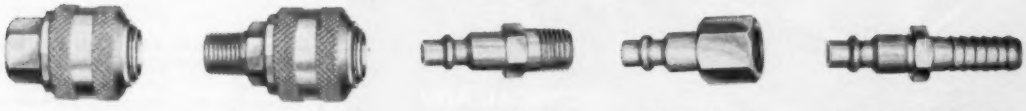

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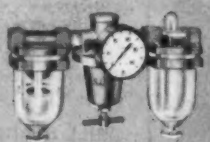

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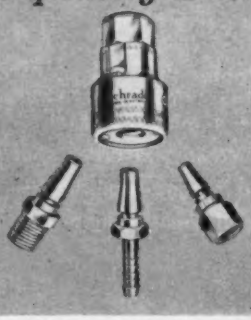

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Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
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Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling
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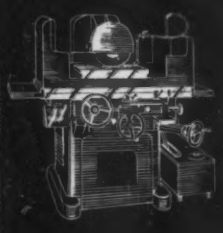
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.

DIE STEELS
Jessop Steel Co., Washington, Penna.



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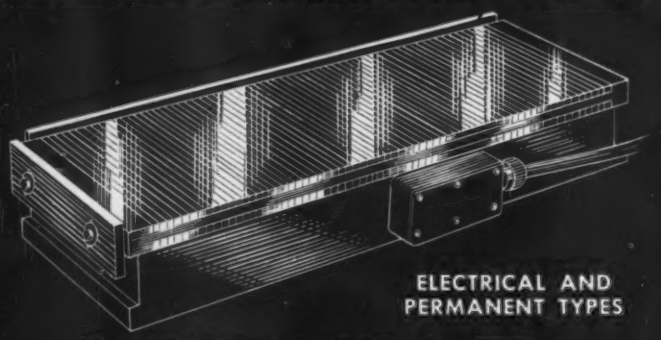

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- Noted For Their Extra Holding Power
- Exclusive Fine-Laminated or New Fine-Grid Types
- Sizes From 5" x 10" To Meet Every Need
- Rectangular and Swiveling — Rotary Models Also Available

Users know – and machine builders, too – a Magna-Lock chuck is a "natural" for a fine machine tool. When you order your new machine, specify it equipped with a Magna-Lock chuck – leading machine tool builders recommend and furnish Magna-Lock. Want details? Write today, Dept. MH59.

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BIG RAPIDS, MICHIGAN, U.S.A. - Telephone 815

Electrical and permanent magnet chucks, sine chucks, parallels, V-blocks, top plates, Magna-Vise

DISINTEGRATORS
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.

DIVIDERS AND TRAMMELS—See Layout and Drafting Tools

DIVIDING HEADS—See Indexing and Spacing Equipment

DOWEL PINS
Allen Mfg. Co., Bloomfield, Conn.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Producto Machine Co., 985 Housatonic Ave., Bridgeport, Conn.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

DRAWING COMPOUNDS
Oakite Products Inc., 26 Rector St., New York 6, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

DRESSERS, Grinding Wheel
DoALL Co., 254 N. Laurel Ave., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Moore Special Tool Co., Inc., 724 Union Ave., Bridgeport, Conn.
Norton Co., 1 New Bond St., Worcester, Mass.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.

DRIFT KEYS
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
DoALL Co., Des Plaines, Ill.

DRILL HEADS, Multiple Spindle
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield 1, Mass.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Middletown, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Thriftmaster Products Corp., 1014 N. Plum St., Lancaster, Pa.
United States Drill Head Co., 616 Burns, Cincinnati, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILL HEADS, Unit Type
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Delta Power Tool Div., Rockwell Mfg. Co., Pittsburgh, Pa.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Kingsbury Mch. Tool Corp, Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Snow Manufacturing Co., Bellwood, Illinois.

DRILL SLEEVES AND EXTENSION HOLDERS
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.

(Continued on page 262)

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To Better Your Production

CIRCLE R Circular Metal Cutting Tools are designed and crafted in this plant, one of the largest anywhere devoted exclusively to this specialty. Our extensive facilities — 45,000 square feet — allow for every refinement in production of fine tools, holding within very precise tolerances where required.

SCIENTIFIC HEAT TREATING is one of our specialties. We use the latest and best obtainable furnaces, with automatic controls. Much of the specialized equipment is our own exclusive design, developed to implement our innovations in heat treating methods.

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CIRCLE R REPRESENTATIVES are at your service in all key markets — specialists in metal cutting, whose advice to you is backed by Factory Consultation Service developed through continuous research and experience since 1923.

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A. D. Spruce

HACKENSACK
The Eaton Company

INDIANAPOLIS
Walter F. Greene & Assoc.

MILWAUKEE
Ford Tool Co.

MONTREAL
Humphrey B. Walton

NEW YORK CITY
J. B. Cramonin (Export)

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General Tool Sales Co.

PHOENIX
DiEugenio Tool Center

PITTSBURGH
Ralph Esposito & Company

PROVIDENCE
Fred J. McMillan

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James O. Horne

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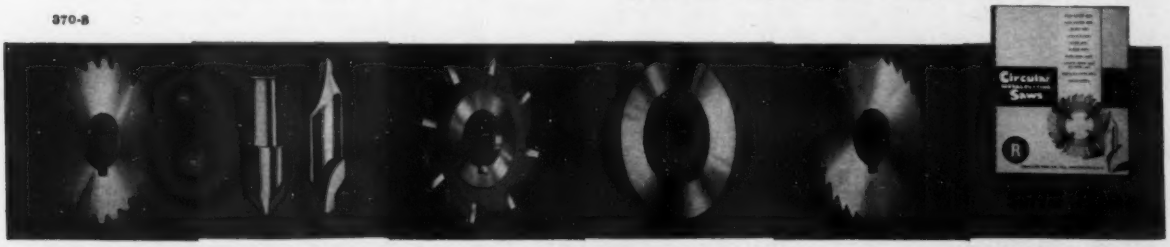


METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR KNIVES & ROTARY SHEAR BLADES • CIRCOLOY STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

For more data, circle this page number on inquiry card 261

DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Automatic Tool Co., Inc., S. 7th & N Sts., Richmond, Ind.

DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

DRILLING AND BORING UNITS, Self-contained

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Watson Ave., Springfield, Mass.
Buhr Machine Tool Co., 839 Green St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co. Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Kaukauna Machine & Foundry Div., Biddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Townsend, H. P. Mfg. Co., Elmwood, Conn.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILLING MACHINE FEEDS, Hydraulic

Beckett-Harcum Co., Wilmington, Ohio

DRILLING MACHINES, Automatic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 12th St., Milwaukee 10, Wis.
Edlund Mchry. Co., Div., Cortland, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Lond Island City 1, N. Y.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

DRILLING MACHINES, Bench

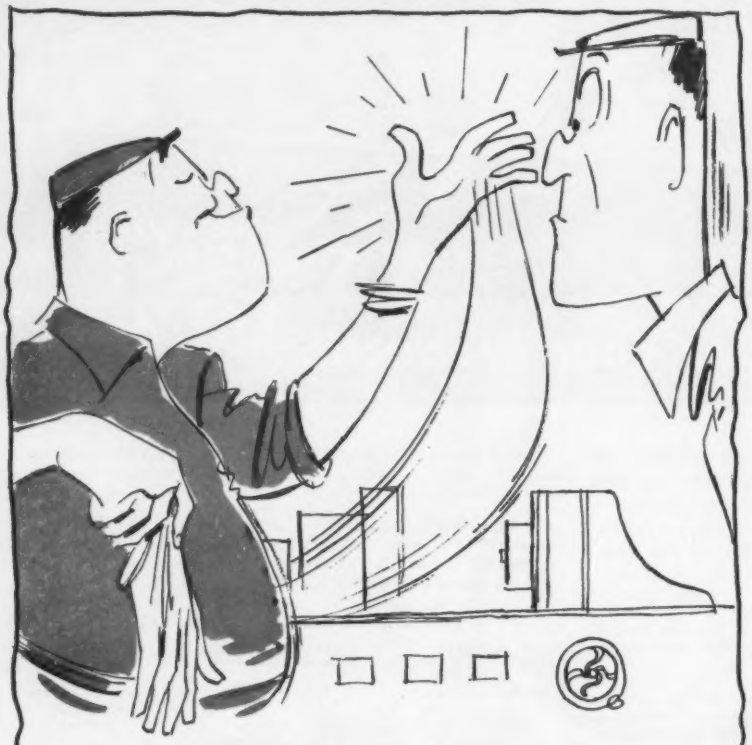
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Hamilton Tool Co., 834 9th St., Hamilton, Ohio.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Leland-Gifford Co., Box 989, Worcester, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.

DRILLING MACHINES, Deep Hole

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Berthiez, Charles, 5 Rue Montalivet, Paris, France.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Leland-Gifford Co., Box 989, Worcester 1, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Wales-Strippit, Inc., Akron, N. Y.

DRILLING MACHINES, Gang, Multiple-spindle

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., Rockford, Ill.
Baush Machine Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 4460 124th St., Milwaukee 10, Wis.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., Box 989, Worcester, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.



New COOLTEX keeps machines cleaner

Your machines don't *have* to feel like a greased pig that's run through a sand pit! If you switch to new Cooltex, they'll practically pass a white-glove inspection. Ask your local Texaco Lubrication Engineer for the details. Texaco Inc., 135 East 42nd Street, New York 17, N.Y.

TEXACO

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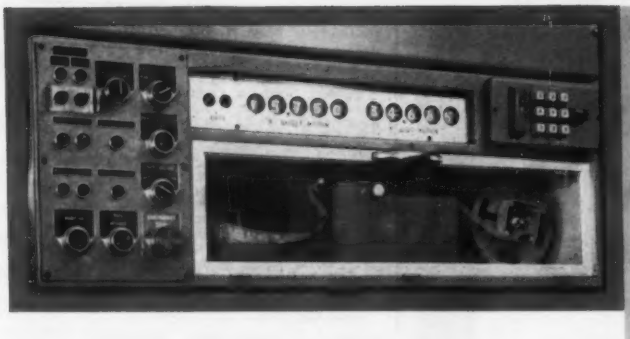
Canada • Latin America • West Africa



CARLTON

CONTROLS CORP.

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A new numerical control just perfected by Carlton Controls Corporation, applied to The Carlton Machine Tool Co. horizontal and planer type boring and drilling machines . . . offers:

1. *Tape control* for automatic 3-axis positioning of tool, plus automatic speed-feed changes. Tape is standard 1" wide 8 channel.
2. *Keyboard* for separate non-taped operations provides manual input of 5- or 6-digit numerical data for each axis. Numerical values, actuated by keyboard or tape, are presented visually by indicator lights.
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4. *Pushbuttons* control rapid traverse and slow traverse power driven units, position the axis movements for manually operating the machine to establish different data points.

For complete information on how any shop can automate boring, drilling, reaming, tapping . . . and make fuller use of drilling machine tools . . . write us today. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

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specialists in boring and drilling machines since 1916

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ONLY

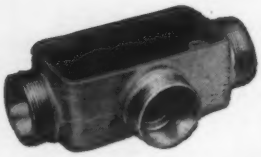
GOSS and DE LEEUW AUTOMATIC CHUCKERS

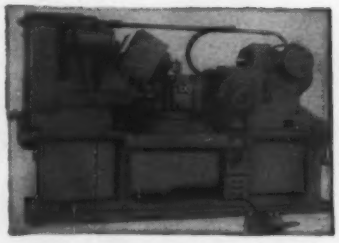
offer the 1-2-3 feature

This NEW development—unsurpassed for speed, convenience of tooling and precise finish—involves no retooling problem even for short runs. It assures greater production at lower cost on all classes of work.

The unique "1-2-3" feature, exclusive with Goss & De Leeuw, provides the means for performing one to three right or left hand single or double threading operations simultaneously or in sequence, without changing set up.

Here's an ideal machine tool for small lot requirements because of quick, easy changeover. Any class of chuck work can be handled economically in any quantity.





The examples of work shown here are typical of the wider variety of parts being produced on these new machines.

SEND FOR detailed information on this new machine. Let us have samples of your work in order to give you time and cost estimates for handling it on the "1-2-3" Goss & De Leeuw.

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

DRILLING MACHINES, Radial

American Tool Works Co., Pearl & Eggleston Ave., Cincinnati, Ohio.
Burg Tool and Mfg. Co., Inc., 15001 Figueroa, Gardena, Calif.
Carlton Mch. & Tool Co., 2961 Meeker St., Cincinnati 25, Ohio
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.

DRILLING MACHINES, Sensitive

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., Inc., 15001 S. Figuera, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207-3211 Disney St., Cincinnati 9, Ohio.
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Edlund Machinery Co., Div., Cortland, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
Leland-Gifford Co., Box 989, Worcester, Mass.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Snow Manufacturing Co., Bellwod, Illinois.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Wales-Strippit, Inc., Akron, N. Y.

DRILLING MACHINES, Universal Radial

Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.

DRILLING MACHINES, Upright

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Barnes, W. F. & John Co., Rockford, Ill.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Burg Tool and Mfg. Co., 15001 S. Figueroa, Gardena, Calif.
Cincinnati Bickford Div., Oakley, Cincinnati, Ohio.
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Ingersoll Milling Mch. Co., 2442 Douglas St.,
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Rehnberg-Jacobson Mfg. Co., 2135 Kishwaukee St., Rockford, Ill.
Snow Manufacturing Co., Bellwood, Ill.
Wales-Strippit, Inc., Akron, N. Y.

DRILLS, Center

Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Circular Tool Co., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

DRILLS, Core

Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Mohawk Tools, Inc., Montpelier, Ohio.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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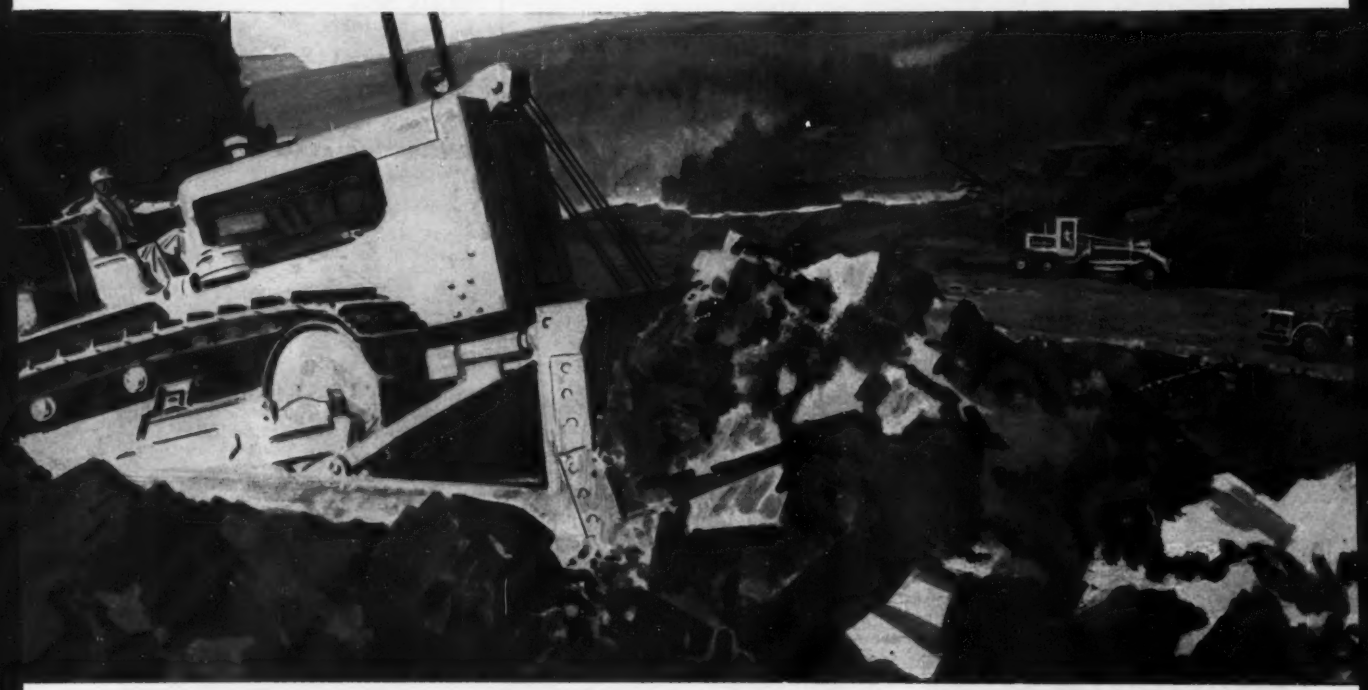
That burly dozer. It's precision built! It's strong! Its massive blade can tear the side out of a hill. Yet, it's nimble, too. In spite of a crab-like figure, it can stop with a jolt, back off, spin, dig in and charge with the force of a galloping rhinoceros.



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National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division
United States Steel Export Company, New York

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DRILLS, Deep Hole, Gun
Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Eldorado Tool & Mfg. Corp., Milford, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.

DRILLS, Oil Hole, Oil Tube
Chicago-Latrobe, 411 Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.

DRILLS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Portable pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Ratchet
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

DRILLS, Subland
Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield. Mass.
Mohawk Tools, Inc., Montpelier, Ohio.

DRILLS, Twist, High-Speed Steel, Carbon Steel
Ace Drill Corp., Adrian, Mich.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped
Ace Drill Corp., Adrian, Mich.
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Wire
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., Cleveland, Ohio
Cogsdill Twist Drill Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DUPLICATING ATTACHMENTS—See Tracing Attachments

DUST COLLECTORS AND CONTROL SYSTEMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

ELECTRICAL DISCHARGE MACHINES—See Disintegrators

ELECTRONIC CONTROL SYSTEMS
Hughes Products, Internationl Airport Station, Los Angeles 45, Cal.
Micro-Path Inc., Ingelwood 2, Calif.
Stromberg-Carlson Div., General Dynamics Corp., 1493 N. Goodman St., Rochester 3, N. Y.

ENGRAVING MACHINES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

EXTRACTORS, Screw
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
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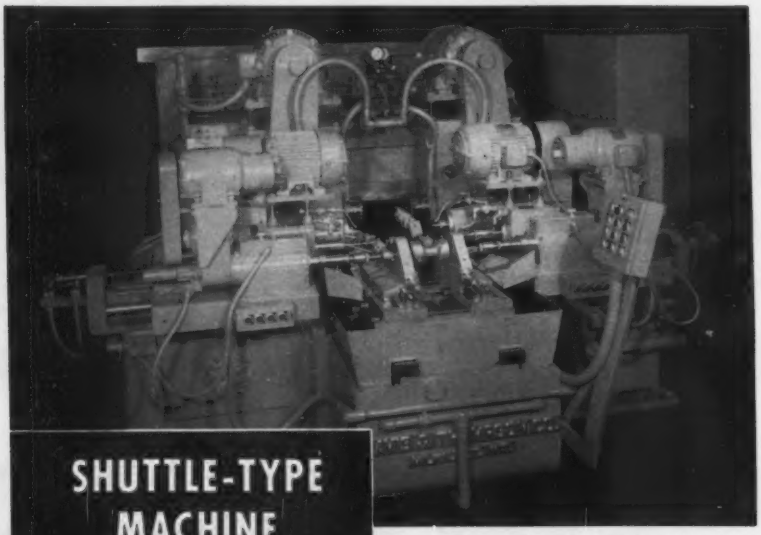
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.



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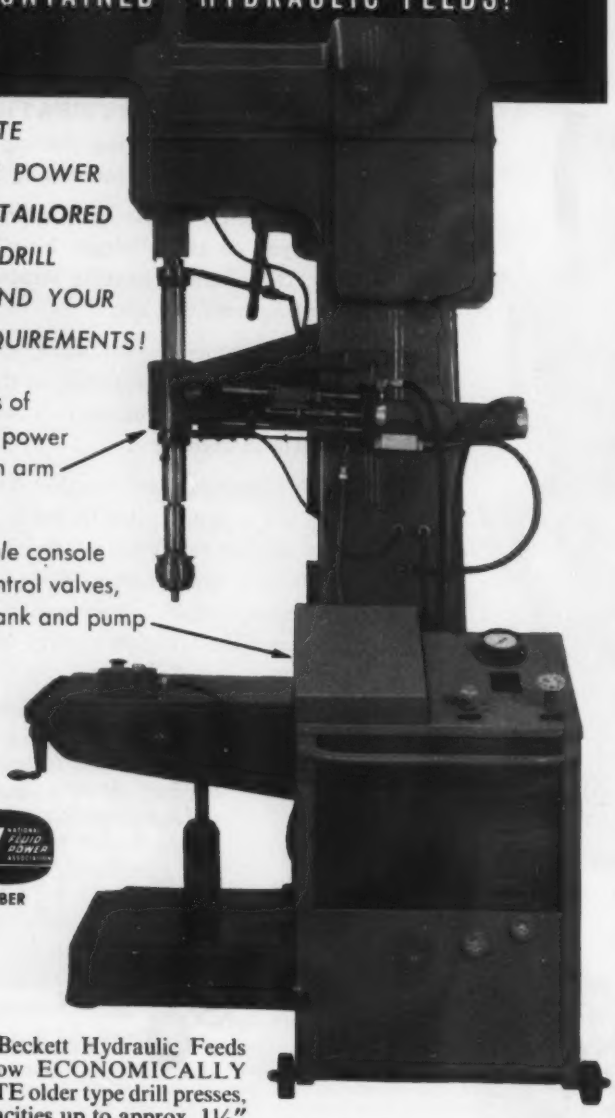

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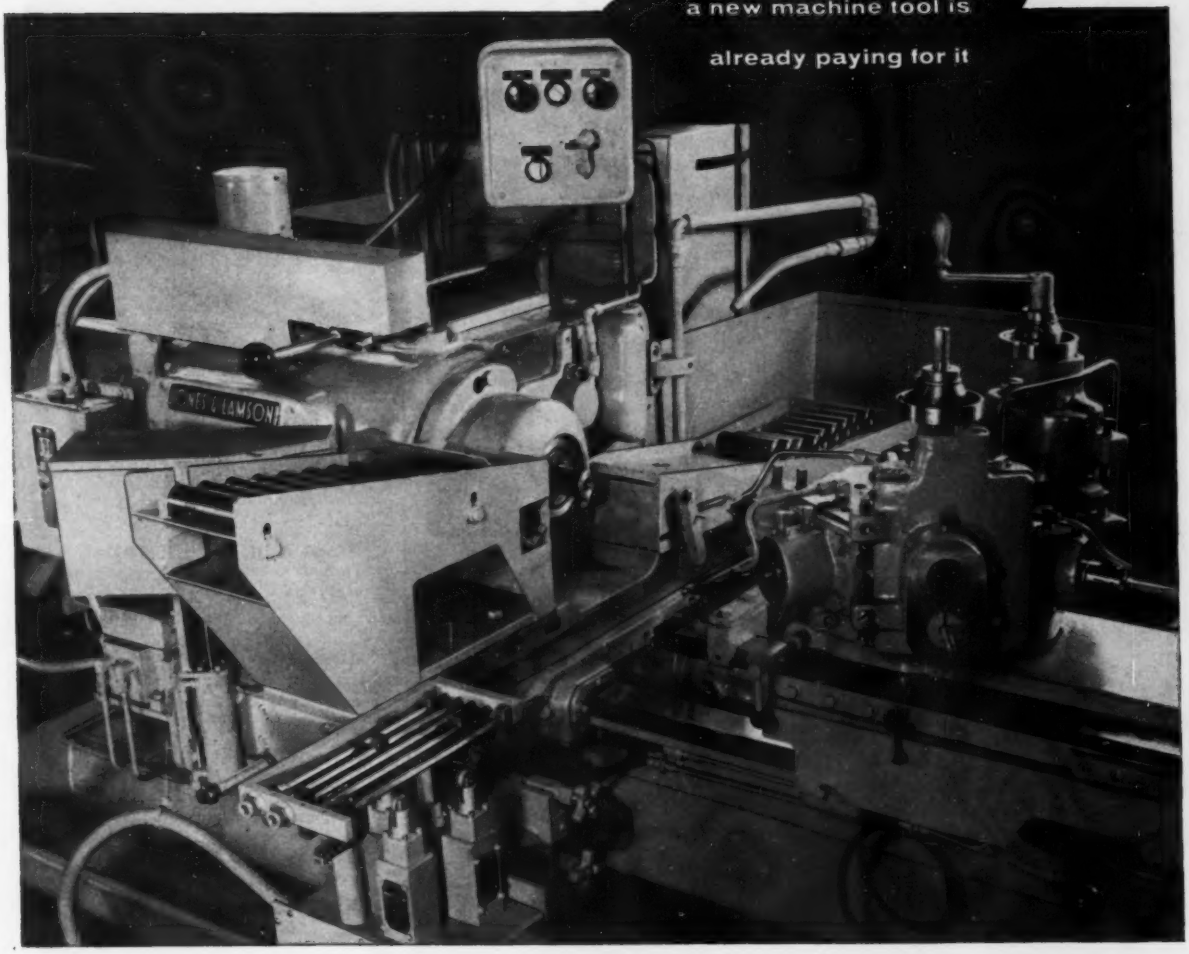

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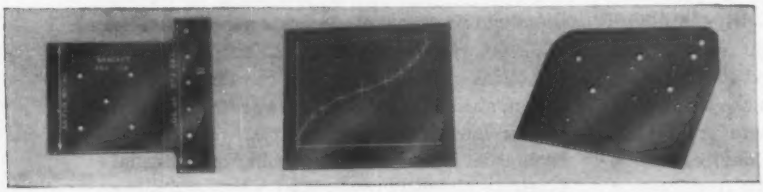

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(Continued on page 274)

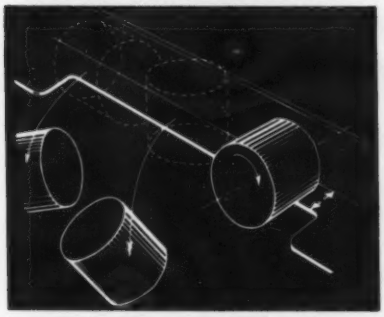
practical automation ideas....no. 3

Storage Unit that Thinks for Itself!

When should a part be stored temporarily between operations? When should it pass immediately to the next operation? A Gear-O-Mation storage unit makes this decision after checking if the loader is full. It either positions the part on the loader for immediate processing, or puts it in "storage" for later demand feeding.

Impossible!—But it Works!

An orientor that repeals the law of gravity? Impossible? Maybe, but Gear-O-Mation has one that's hard to believe.



Parts roll down an "L"-shaped track which narrows to *slightly less than one-half width of part!* Correctly rolling parts roll on across for further processing; others just tumble off and go back to the start of the track.

What's your concept of automation? A vast array of inter-connecting machining operations untouched by human hands? Actually, all automation comes down to a series of small devices—feeders, orientors, escapements, conveyors, etc. Dozens of typical devices are illustrated in Gear-O-Mation's "Idea File". Ask your Gear-O-Mation field engineer to show you his.

Magnetic Handling with Fabric Belt

Small irregular shaped parts can be elevated or directed into orientors with fabric belts backed by permanent magnets in such a way that only those correctly positioned will enter the demand-feed chute.

Single Loader for Multiple Feeder

Where it is desired to load parts into a multiple feeder (as for a heat-treat oven) they can be picked off a single chute, dropped into a multiple "Velvet-Drop" (patented) feeder which keeps all channels of the multiple feeder loaded, provides temporary storage to keep them full.

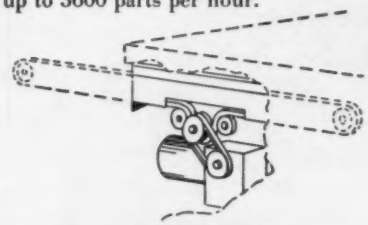
Most people think of automation as something built into the original installation. That's a good way to do it, but you don't have to do it that way. If you want to automate your existing operation this can be done very effectively, too. In either case, Gear-O-Mation's experts can automate your machining operation to any degree desired—make it deliver all of the potential designed into it.

Track: Fast, Clear and Adjustable!

A simple answer to handling parts of different dimensions—as when a design change is made—is an adjustable-track conveyor. Side plates and rails are moved in or out, quickly adjusted for smaller or larger part width. Parts roll on spring steel rails. Soils, chips, cuttings, etc., fall through, making the conveyor self-cleaning.

One Belt Does Two Jobs

Sometimes you can use the same belt to unload parts from one machine and load them into another by using a center drive gear head motor with a wrap-on sprocket. A typical Gear-O-Mation installation of this type handles up to 3600 parts per hour.



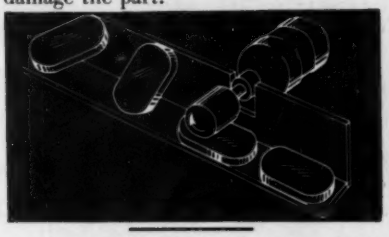
Automation begins with the coupling of two machines, often through a simple elevator and a gravity chute. From this you can go almost to infinity. Gear-O-Mation has the experience and ingenuity to point the way and design the equipment for the exact degree of automation your operation requires and warrants.

Handling Parts in Pre-Set Groups

In automation, parts don't have to be handled one-at-a-time only. Sometimes it works better to process them in groups of preset quantities, using a feeder that meters and releases the precise number required. For example, in one plant, eight plastic fishing reels are aligned and placed on a spindle for simultaneous group winding.

Pencil Wheel Orientor

A small grinding wheel can be used to orient light parts by knocking down all parts which try to pass in an upright position. The light 'bite' of the wheel gives positive action but does not damage the part.



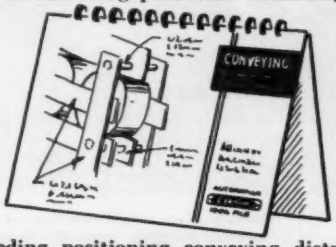
Gear-O-Mation doesn't believe in its customers having to pioneer untried ideas. Where a new principle is involved, we make sure of it first. Mostly, however, we go back to established principles we all KNOW will work.

Demand Storage for No-Roll Parts

Where parts can't roll you can move many rows of them through storage by a simple, moving disc with fixed guide rails. One such Gear-O-Mation unit collects, stores and feeds up to 3000 small parts.

NEW "IDEA FILE"

Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting,



feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon below.

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Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

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GRADUATING MACHINES

Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag

Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummurt-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

GRINDERS, Die and Mold

DoALL Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Oliver Instrument Co., 1410 E. Maumee, Adrian Mich. (also drill point thinner)
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

GRINDERS, Face Mill

Kearney & Treaker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear

Hill Acme Co., 1201 W. 65th St. Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Electric

Chicago Pneumatic Tool Co., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.
Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., Niles, Ill.

GRINDERS, Tap

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro Pa.
LeBlond, R. K. Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co, 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

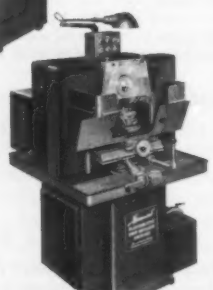
GRINDING GAGES—See Gages, Grinding

HAMMOND ELECTROLYTIC GRINDERS

are doing a job at Beech— a leading builder of aircraft

Hammond ELECTROLYTIC CHIP BREAKER AND OSCILLATING CUP WHEEL GRINDERS CUT CARBIDE TOOL GRINDING COSTS . . . greatly reduce diamond wheel consumption.

MODEL SCE-6



MODEL CBE-6

Today more and more manufacturers are turning to Hammond Electrolytic Carbide Tool Grinders to reduce their carbide tool grinding costs. Carbide is removed by electro-chemical action with the diamonds wiping away the products of electro-chemical decomposition. As a result —

- Diamond wheel consumption is reduced 80% to 90% and green wheel grinding eliminated.
- Grinding is done faster and better with less physical effort.
- Heat fractures are eliminated as the process is cool.

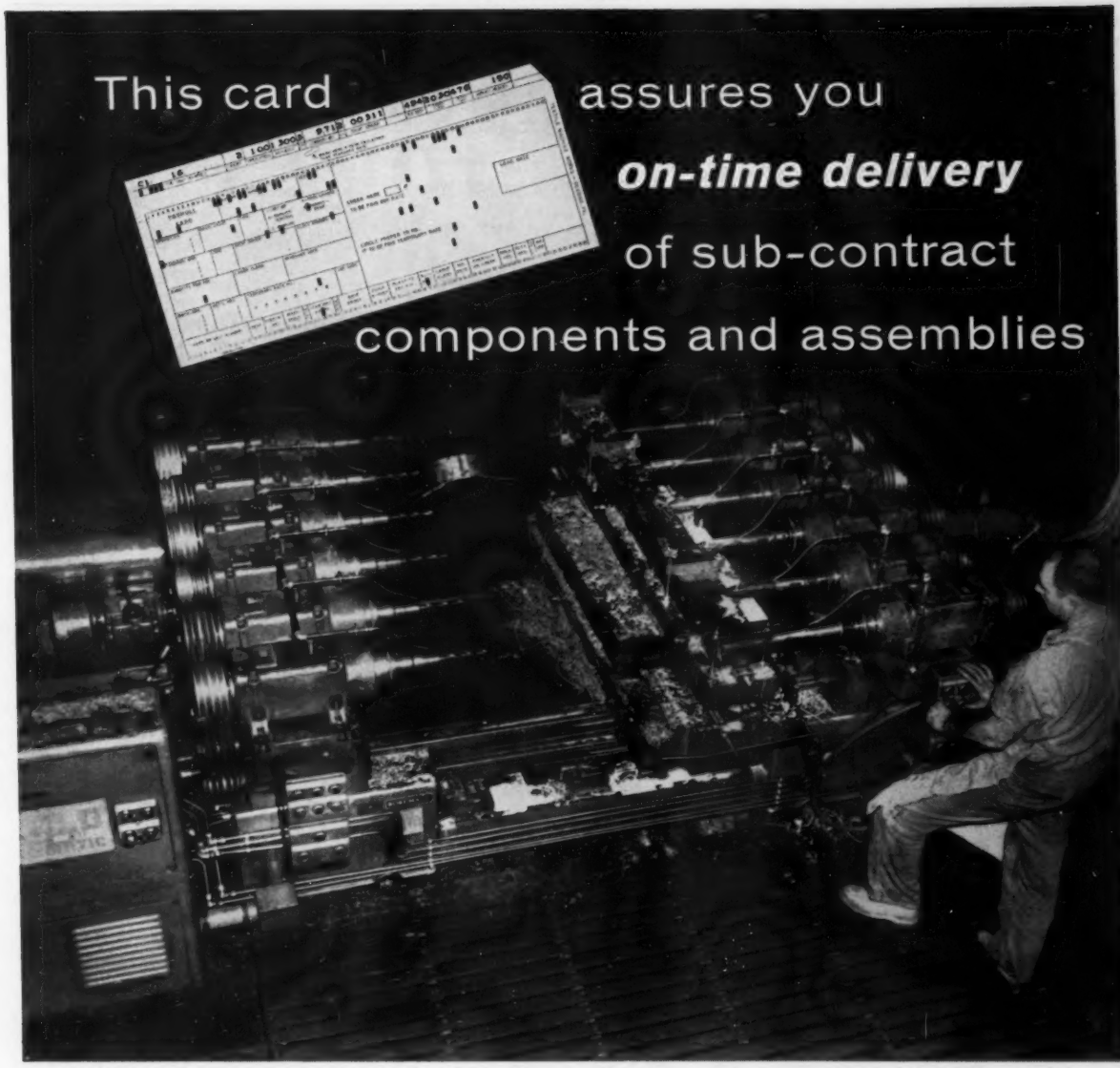
Many users report their installation paid for itself in a matter of months. If you grind many carbide tools, you are actually paying for a Hammond Electrolytic Grinder, therefore — *WHY NOT USE IT?*

Write for catalog.

Hammond OF KALAMAZOO "Good Machinery Since '82"

Hammond Machinery Builders INC.

1619 DOUGLAS AVE. · KALAMAZOO, MICH.



It's a small but important part of TMW's electronic punched card scheduling and control system. And it's your assurance that sub-contract jobs, regardless of size or quantity, are delivered *on time*.

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Textile Machine facilities include 1200 modern machine tools of all types and sizes, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen, plus a corps of the industry's top designers and engineers.

Combine these facilities with modern electronic production scheduling controls and quality control techniques . . . and you've got the perfect answer to all your sub-contract problems.

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TEXTILE MACHINE WORKS

Contract Division • Reading, Pennsylvania

For more data, circle this page number on inquiry card

GRINDING MACHINES, Abrasive Belt
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean Detroit 13, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless
Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Machine Co., 3640 Main St. Springfield 7, Mass.

GRINDING MACHINES, Crankshaft
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Landis Tool Co. Inc., Waynesboro, Pa.
Micromatic Hone Corp., 81100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd. Cincinnati 4, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc
Brown & Sharpe Mfg., Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Co., Beloit, Wis.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11 Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight S. W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll
Landis Tool Co. Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating
Brown & Sharpe Mfg., Co., Providence, R. I.
Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Mattison Machine Works, Rockford, Ill
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

• *Higher Cutting Speeds*
• *Lower Production Costs*

NEW Jarvis PRODUCTS!

NEW SOLID CARBIDE CUTTING TOOLS

J015 Boring Tool

J704 Countersink

J564-R Reamer

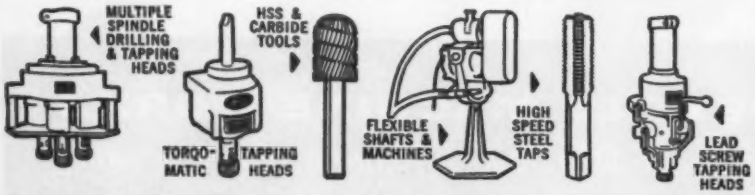
The New "Drillspeeder"

The Jarvis Drillspeeder converts your ordinary drill press into a high speed drilling machine! This new precision attachment features a 4 to 1 gear ratio, is adaptable to any conventional style of drill press spindle.

Maximum speed of 30,000 RPM is ideal for high speed drilling of small holes . . . permits effective use of solid carbide drills and reamers. Chuck capacity range from No. 80 to 5/32" shanks.

Lower your production costs with Jarvis solid carbide cutting tools! These rugged carbide tools let you use optimum speeds and feeds . . . stay sharp and accurate longer between grinds.

The tools shown above are only a few of the many new standard items just added to the Jarvis line of cutting tools. Jarvis makes a complete selection of solid carbide drills, end mills, reamers and rotary files.

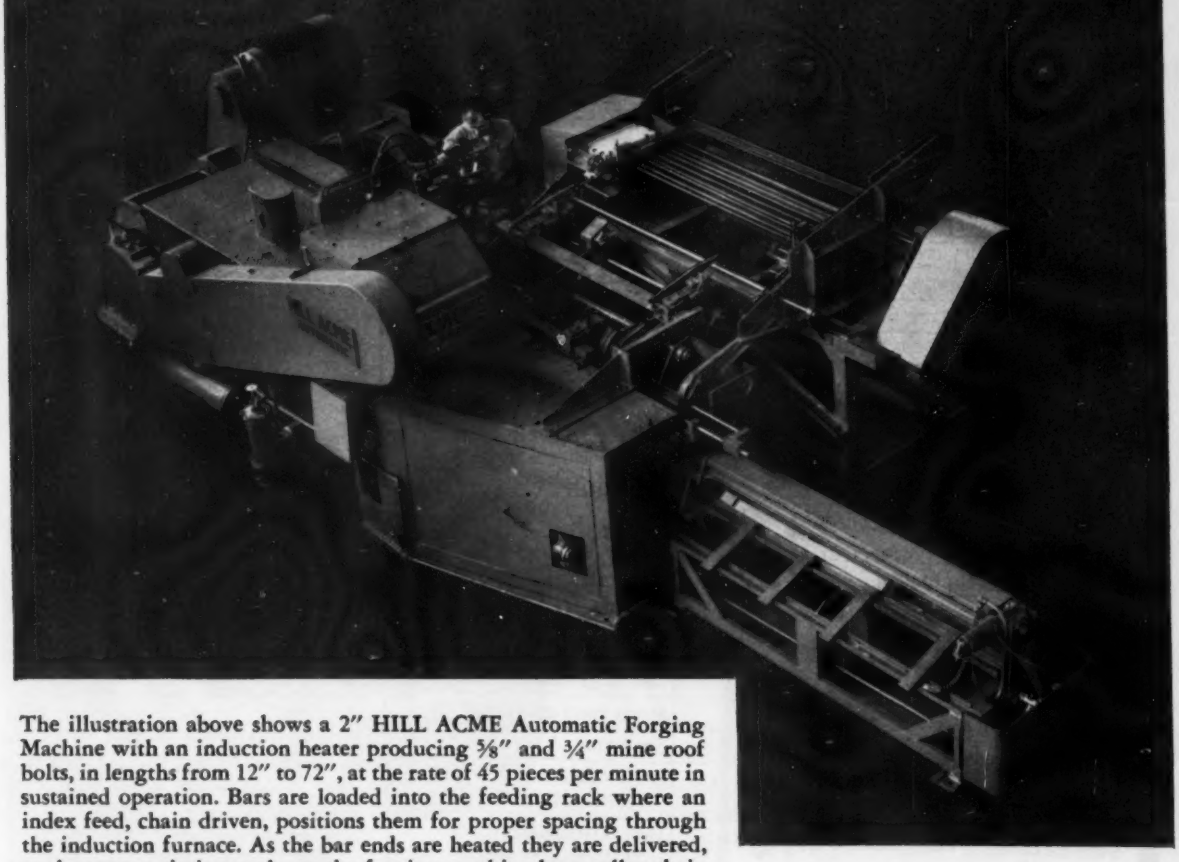

MULTIPLE SPINDLE DRILLING & TAPPING HEADS
HSS & CARBIDE TOOLS
TORQ-MATIC TAPPING HEADS
FLEXIBLE SHAFTS & MACHINES
HIGH SPEED STEEL TAPS
LEAD SCREW TAPPING HEADS

JARVIS CORPORATION • MIDDLETOWN, CONNECTICUT

Fully Automatic

FORGING MACHINE

DELIVERS 45 PIECES PER MINUTE!



The illustration above shows a 2" HILL ACME Automatic Forging Machine with an induction heater producing ⅝" and ¾" mine roof bolts, in lengths from 12" to 72", at the rate of 45 pieces per minute in sustained operation. Bars are loaded into the feeding rack where an index feed, chain driven, positions them for proper spacing through the induction furnace. As the bar ends are heated they are delivered, at the proper timing cycle, to the forging machine by a roller chain feed where they are gauged for length, picked up by fingers and passed progressively through the dies. Finished forgings are discharged from the back of the machine by means of a separately driven conveyor, arranged for both right and left hand discharge.

The design of this new HILL ACME AUTOMATIC forging unit does not limit the number of passes or the length of stock to be used in forging a variety of parts. Pieces longer than 36" are supported by a walking beam through the various passes.

HILL ACME AUTOMATIC forging machines are built in 1¼" to 5" capacities all of which can be automated. Your inquiry concerning high speed automatic forging equipment will receive prompt attention.

The HILL ACME Company

1207 W. 65th STREET • CLEVELAND 2, OHIO

Manufacturers of: "ACME" FORGING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • ROTARY SHEARS • BAR-BILLET SHEARS • "HILL" ABRASIVE ING AND POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • "CLEVELAND" KNIVES • SHEAR BLADES • MATERIAL HANDLING EQUIPMENT

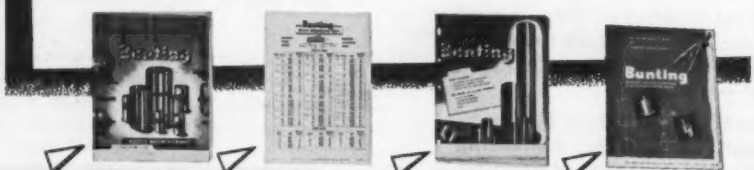
For more data, circle this page number on inquiry card

CHECK LIST for a BEARING BUYER

PRODUCT — BEARINGS, BUSHINGS AND SPECIAL PARTS OF CAST BRONZE OR SINTERED METALS ALCOA® ALUMINUM BARS

FIRM NAME — The Bunting Brass and Bronze Co., Toledo 1, Ohio

	YES	NO	REMARKS
Are its products available from stock?	✓		Readily
Do local distributors have stocks?	✓		All over America
Cast Bronze Bearings	✓		866 sizes
Sintered Oil-filled Bronze Bearings	✓		667 sizes
Cast Bronze 13" Bars	✓		267 sizes
Sintered Oil-filled Bronze 6½" Bars	✓		84 sizes
Aluminum 13" Bars	✓		138 sizes
Is it a high quality product?	✓		Bunting 72 Bronze Alloy (SAE 660) Alcoa Aluminum
Are stock sintered bearings made to ASTM Standards?	✓		Always
Any restrictions on quantity?		✓	Small lots at big run prices
Does it render extraordinary service in emergencies?	✓		Large reserve facilities
Does it have ample production capacity?	✓		Two large modern plants
Is the range of stock sizes complete?	✓		Meets every usual need
Does the company publish catalogs?	✓		See below
Does it publish technical data?	✓		In all catalogs and in special literature
Does the company make products to blueprint?	✓		Over 50,000 patterns for customer free use
Does it give competent engineering aid?	✓		It's free
Is the company well established?	✓		Over 50 years



CATALOG 258 lists Electric Motor Bearings.

BAR CARD 40 lists 138 sizes of Bunting Bearing Aluminum 13" Bars.

CATALOG 58 lists Bunting Cast Bronze and Sintered Oil-filled Bronze Bearings and Bars.

BUNTING'S "ENGINEERING HANDBOOK ON POWDER METALLURGY" details manufacture and use of sintered metal bearings and parts.

Write for Catalogs or ask your Distributor

Bunting® local distributors are listed in classified section of telephone directory under "BARS-BRONZE" or "BEARINGS-BRONZE"

For more data, circle this page number on inquiry card

GRINDING MACHINES, Surface Rotary
Berthiez, Charles, 5 Rue Montalivet, Paris, France
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio.
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W, Grand Rapids 2, Mich.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Tool Co. Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Olivetti Corp of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.

GRINDING WHEEL DRESSING AND FORMING DEVICES
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling Machine Company, Cincinnati Milling Products Div., Marburg Ave., Cincinnati 9, Ohio
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.

GROOVING TOOLS, Internal
Kennametal, Inc., Latrobe, Penna.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Pneumatic
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HAMMERS, Power
Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.

(Continued on page 280)

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between maximum performance and moderate cost . . .

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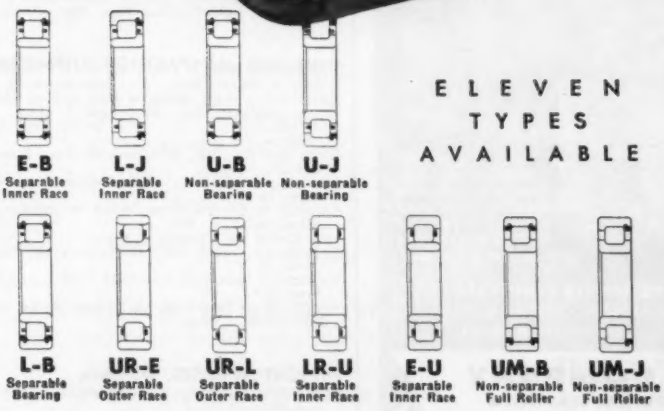
Give you more for your bearing dollar

For those hundreds of in-between applications where performance requirements are more exacting than those provided by the ordinary commercial bearing, but where maximum precision would be unneeded precision – specify Tru-Rol for the job.

Tru-Rol Bearings provide above-commercial-grade efficiency . . . at worthwhile savings in cost. Internal clearances are closely controlled. Rollers are equally spaced to eliminate out-of-balance vibration. Each roller is crowned to distribute the load evenly along the full length of the roller. Eleven types available in single and double width bearings, in stamped steel retainer, segmented retainer or full roller construction.



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ROLLWAY® BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

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Erie Foundry Co., 1253 W. 12th St., Erie Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDENING FURNACES
General Electric Co., Schenectady, N. Y.

HARDNESS TESTERS
Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co. Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

HOISTS, Air
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HOISTS, Electric
Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreno St., Elkhart, Ind.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

HONING STONES
Barnes Drill Co., 814 Chestnut Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

HOSE
American Metal Hose Br. American Brass Co., 35 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

HYDRAULIC MACHINERY
Tools and equipment
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Bliss E. W., Co., 1375 Raff Rd., E. W. Canton, Ohio
Burg Tool and Mfg Co., Inc., 15001 S. Figueora, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., Erie, Pa.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
Northern Hydraulics & Mch. Corp., Melrose Park, Ill.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St. Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Vickers Incorporated Div. of Sperry Rand Corp., 1402 Oakman Blvd., Detroit, Mich.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

HYDRAULIC POWER UNITS OR TOOL HEADS
Barnes Drill Co., 814 Chestnut, Rockford 3, Ill.
Barnes W. F. & John Co., 201 S. Waterford St., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT
Brown & Sharpe Mfg., Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

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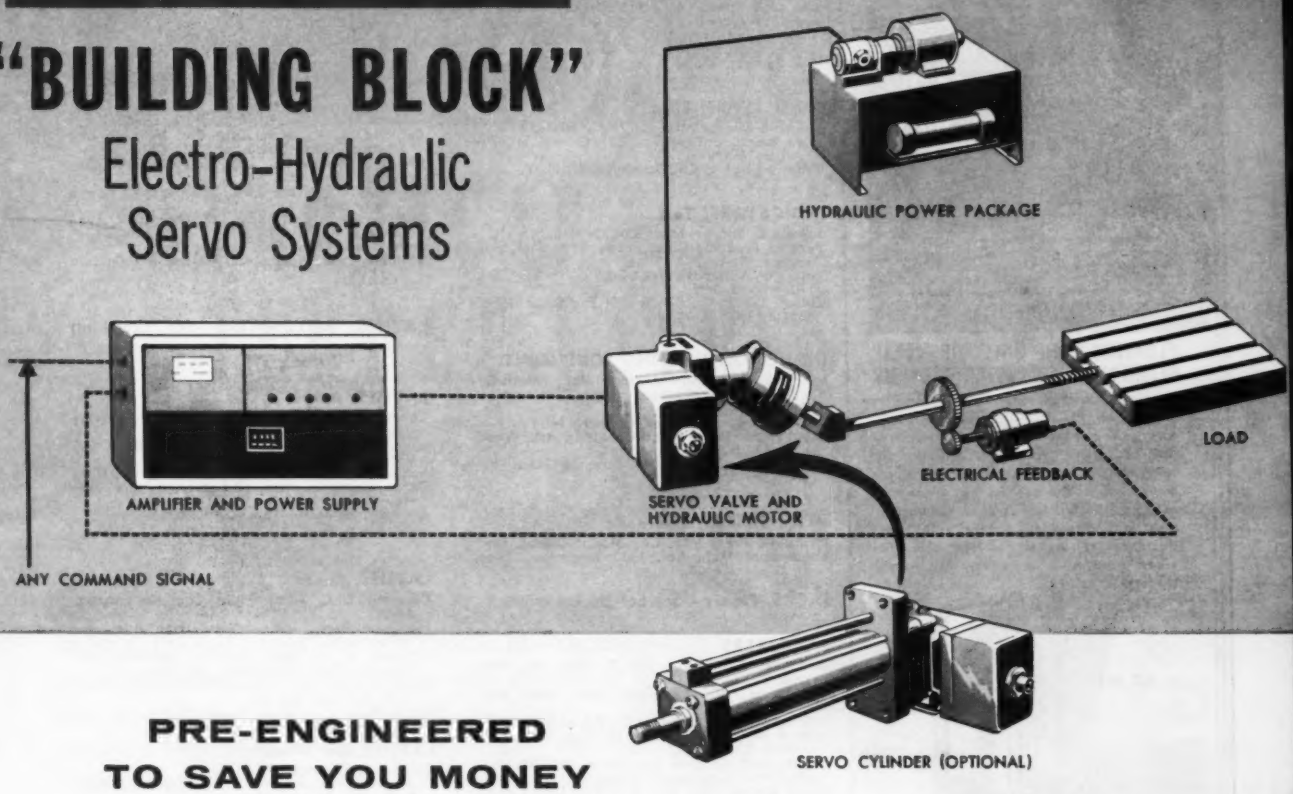
Electro-Hydraulic Servo Systems



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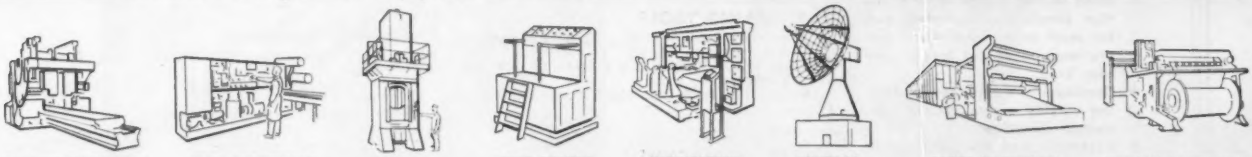

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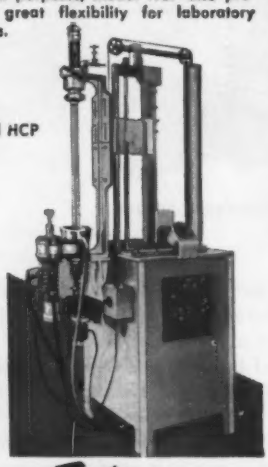

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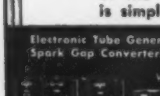

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National Automatic Tool Co., S. 7th-N. Sts., Richmond, Ind.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
General Electric Co., Schenectady, N. Y.

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Federal Products Corp., 1144 Eddy St., Providence, R. I.
National Automatic Tool Co., S. 7th & N. Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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General Electric Co., Schenectady, N. Y.
Lepel High Frequency Laboratories, Inc., Woodside 77, N. Y.
Orban, Kurt Co., Inc., 42 Echange Place, Jersey City 2, N. Y.

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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.

JACKS, Planer—See Set-Up Equipment

JIG BORERS
American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban Kurt., Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES
Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS
Baker Bros Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mas.

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Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio.
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4235 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle
Consolidated Mch. Tool Div., Farrel-Birmingham Co. Inc., Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp. Hamilton, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt. Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds. Cincinnati 18, Ohio
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel
Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Crankshaft
Consolidated Mch Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds, Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End
Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

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Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney Ohio
Sidney Machine Tool Co., Highland Ave., Sidney, Ohio

LATHES, Engine, Manufacturing
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Carroll-Jamieson Mch. Tool Co., Batavia, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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(Continued on Page 284)

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Model 75

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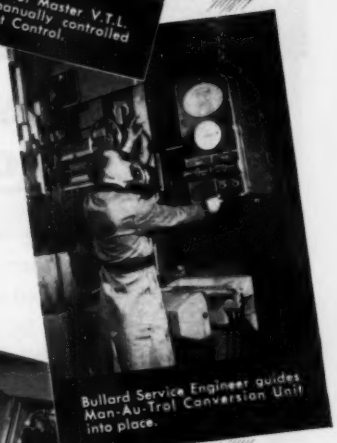

Bullard Service Engineer guides Man-Au-Trol Conversion Unit into place.

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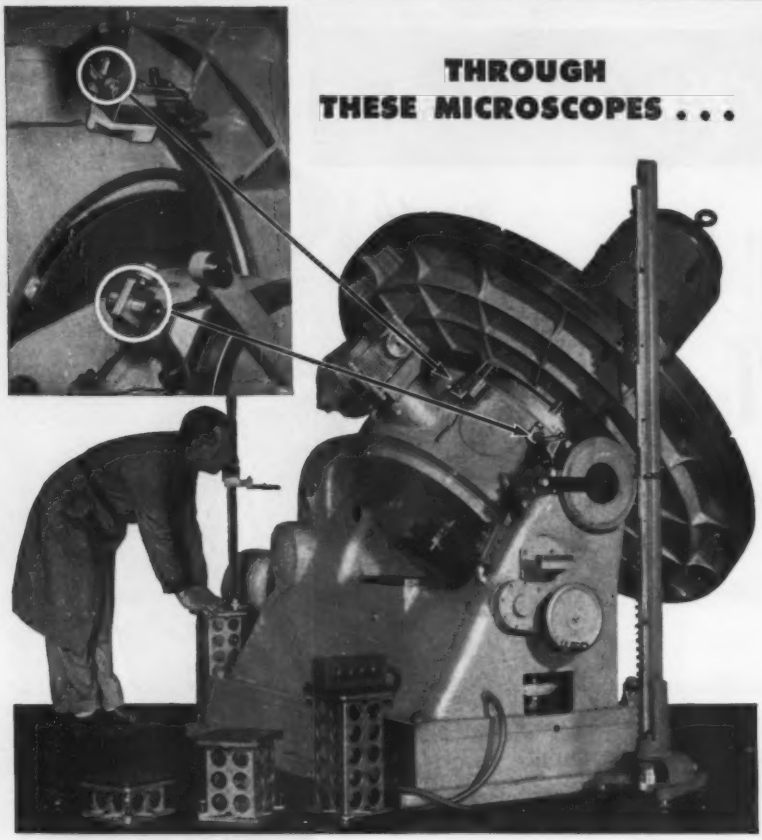

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Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Engine, Toolroom

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Carroll-Jamieson Mach. Tool Co., Batavia, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.
Hendey Mch Div., Barber Colman Co., Rockford Ill.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio

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Clearing Div., of U. S. Industries, Inc., 649 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
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LATHES, Roll

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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton Ohio
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Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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Gisholt Machine Co., 1245 E Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Monarch Mch. Tool Co., Oak St., Sideny, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning

Cincinnati Milling Machine Co., Meta-Dynamics Div., Marburg Ave., Cincinnati 9, Ohio (Hydrospin)
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Jones & Lamson Mch. Co., 512 Clinton St., Springeld, Vt.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES Turret, Ram Type, Saddle Type

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Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Hardinge Brothers, Inc., 1420 College Ave., Elmira N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
Sheldon Mach. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

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MANDRELS—See Arbors and Mandrels

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Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Slocomb, J. T. Co., Glastonbury, Conn.
Van Keuren Co., 176 Waltham St., Watertown 12, Mass.

MICROSCOPES, Toolmakers'

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Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

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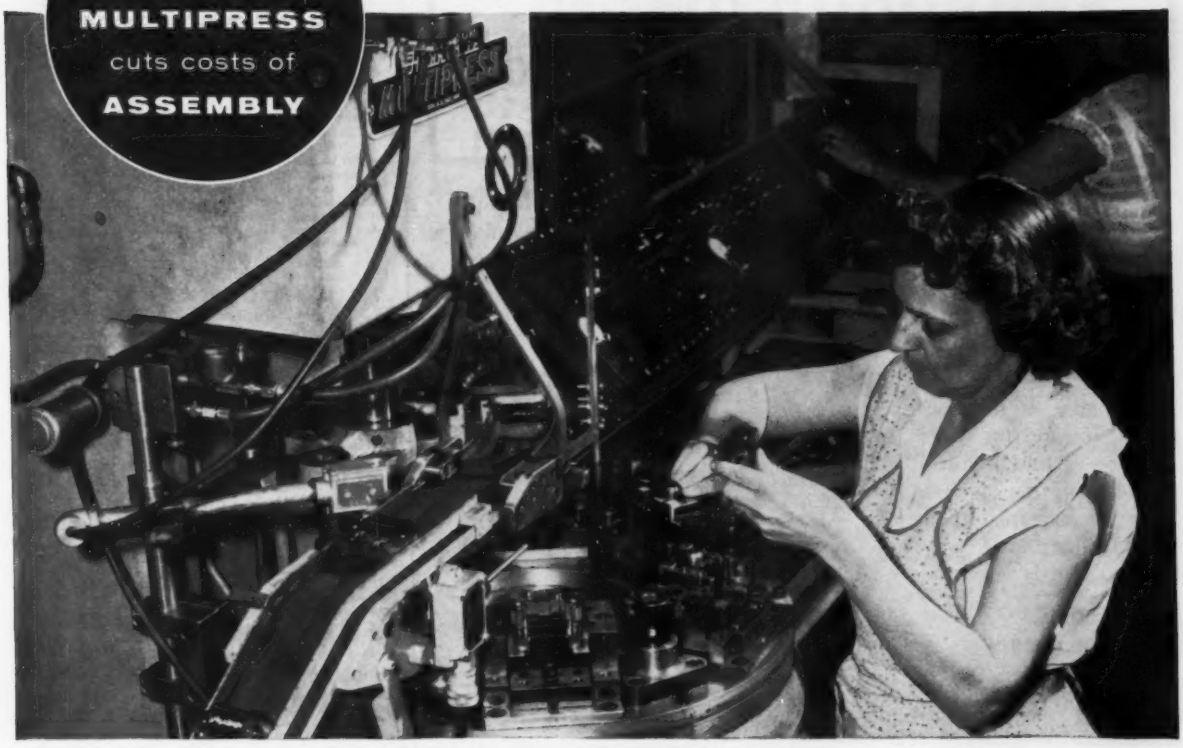
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.

(Continued on Page 288)

How **DENISON MULTIPRESS** cuts costs of **ASSEMBLY**

ONE OF THREE, *this Denison 4-ton hydraulic Multipress is equipped with 6-station automatic index table to assemble both halves of lamination stacks of small electric motors.*



Savings with **DENISON** Multipress justify MAPI replacement recommendations at **BARBER-COLMAN**

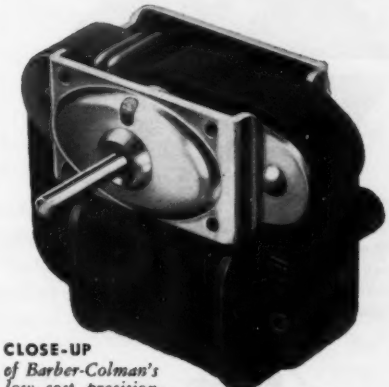
... line of 3 new hydraulic presses simplifies and speeds small motor assemblies

Installed upon recommendation of a MAPI replacement analysis, three Denison hydraulic Multipresses are today meeting predicted cost reductions in assembly operations at Barber-Colman Company, Rockford, Illinois.

Operating in a line and connected by conveyor belts, these three hydraulic presses handle—on a semi-automatic basis—such operations as bending, staking, aligning, compressing, riveting and stamping in the production and assembly of small electric motors.

In addition to more efficient handling of production functions, the quality of output is more uniform because exact pressure is duplicated on each stroke of the hydraulic ram.

Savings in cost and uniform production like this can be duplicated in your shop today. A cost reduction study by a Denison Specialist in press work can show you how. Write today for a descriptive catalog on the complete Multipress line.



CLOSE-UP *of Barber-Colman's low-cost, precision-made, AC non-geared motor... assembled by Denison Multipresses.*

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1152 Dublin Road • Columbus 16, Ohio

Denison Stocking Branch Offices: LOS ANGELES • HOUSTON
CHICAGO • DETROIT • ATLANTA • NEWARK • CLEVELAND

DENISON HydrOILics

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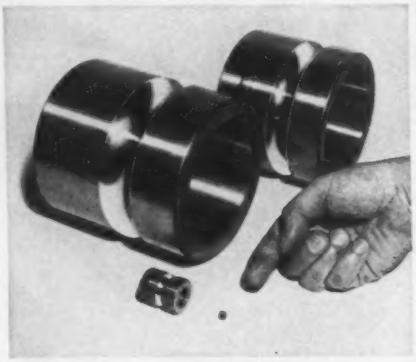
For more data, circle this page number on inquiry card

WHY MICROHONE* YOUR CRITICAL ANTI-FRICTION BEARING SURFACES? BECAUSE...

Bearing loads and speeds, in common use today, demand critical bearing surfaces that are accurate, have correct geometry and proper surface finish. Also, the process that generates these surfaces must keep production costs to a minimum.

MICROHONING INCREASES PRODUCTION

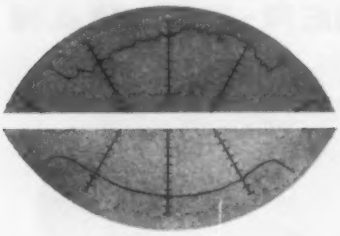
Microhoning is the first successful method for automatic processing and handling of raceway rings on multiple machines. It increases production several times over output of former methods.



Raceways of inner and outer rings for ball diameters ranging from .062" to 1.50" are currently being Microhoned.

MICROHONING IMPROVES BEARINGS

The ability of Microhoning to greatly improve the functional characteristics of critical bearing surfaces is even more significant. For instance . . . quieter-running, longer-life ball bearings are obtained because Microhoning of races assures:



Comparative Talyrond charts—each division of radial lines equals 50 millionths of an inch. Top: raceway curvature of a finished, unhoned precision bearing. Bottom: curvature of Microhoned raceway.

1 Improved concentricity between raceway and bore;

2 Removal of humps in raceway and trueing of plane of track;

3 Correct track curvature for greater contact with balls;

4 Simultaneous improvement of accuracy and surface finish.

Critical checking on precision instruments, and comparative performance studies have convinced many bearing makers and users that Microhoned bearings run smoother, quieter, and longer than those processed by any other method.

**Registered U.S. Pat. Off.*

For further information, write to:

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE • DETROIT 38 MICHIGAN

Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Automatic

Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Consolidated Machine Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type, Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island 1, N. Y.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.

MILLING MACHINES, Circular, Continuous

Consolidated Mch. Tool Corp., Rochester, N. Y.
Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Nichols, W. H. Co., Waltham 54, Mass.
Olivetti Corp. of America, 42-33 Northern blvd., Long Island City 1, N. Y.
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

MILLING MACHINES, Die Sinking, Duplicating, Profiling

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Sundstrand Mch. Tol Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio

Clearing Div., of U.S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo., Mch., Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Homestrand Machine Tool Corp., 380 W. Putman Ave., Greenwich, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., Niles, Ill.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 11110 W. 13th St., Racine, Wis.
Homestrand, Inc., Larchmont, N. Y.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Planer Type

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker, Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

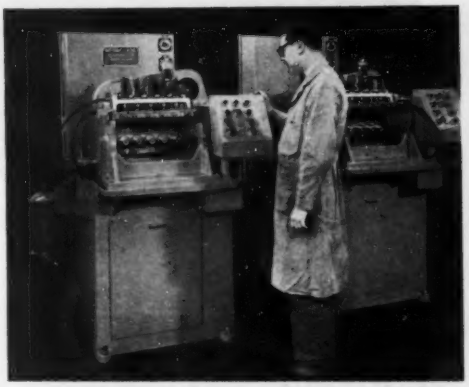
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.

(*Continued on page 290*)

HOW MICROHONING* OF CRITICAL BEARING SURFACES ASSURES QUIETER-RUNNING, LONGER-LIFE

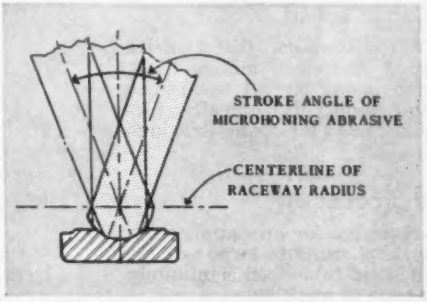
Because Microhoning is the first successful method for automatic processing and handling of anti-friction raceway rings on multiple spindle machines, production is several times higher than former methods.

In addition, here's how application of basic Microhoning principles (a combination of motions, low-velocity abrading, controlled pressure, float in tool) improve the functional characteristics of bearings: concentricity, track curvature, waviness, accuracy, surface finish.



Typical five-spindle machines for Microhoning bearing raceway. Typical production: bring high-band reading (Waveometer) of raceway waviness below one microinch, rms . . . five rings in a 20-second cycle.

Tools are positioned on an oscillating bridge so that abrasive sticks pivot about the centerline of raceway arc to generate a true radius. As rings rotate, irregularities are removed from track leaving a clean surface that is free of smeared or deformed metal. During final seconds of Microhoning cycle, speed of oscillation is automatically reduced to generate a lay pattern that runs circumferentially around the track.



Because abrasive stick pivots about centerline of raceway while rings are rotating, Microhoning improves raceway curvature, waviness, surface roughness and lay.

Microhoning technique can also be applied to raceways of cylindrical roller, tapered roller, needle, thrust and self-aligning bearings . . . also, other critical bearing surfaces.

For further information, write to:

**Registered U.S. Pat. Off.*

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

For more data, circle this page number on inquiry card

RIGIDITY + SPEED

for nonferrous face milling

a new achievement in design

All the advantages of high speed rotary table feed . . . with rigidity in overall construction *for machining accuracy* equal to that of the finest bed type machine.

a new dimension in speed

Equipped with the famous direct drive Onsrud high speed motorized milling head. Ample power and speed for all nonferrous milling. Precision built, dynamically balanced, air or liquid cooled for continuous high speed operation.

a new range in productivity

Unequalled productivity for any application from short "job shop" runs to large volume production. High speed table feed is infinitely variable for any type of work.

ONSRUD MM-48 ROTARY FEED VERTICAL MACH-MIL

Complete information . . . write for Bulletin 1176

ONSRUD MACHINE WORKS, INC.

7716 LEHIGH AVENUE • NILES 48, ILLINOIS
(Suburb of Chicago)

Telephone: Niles 7-8700 • Cable Address: Onsrudmach

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Electric

Brook Motor Corp., 3302 W. Peterson Ave., Chicago 45, Ill.
General Electric Co., Schenectady, N. Y.
Lincoln Electric Co., Cleveland 17, Ohio
Onsrud Machine Works, Inc., Niles, Ill.

MOTORS, Hydraulic

Barnes, John S. Corp., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hydraulic Press Mfg. Div., Mt. Gilead, Ohio
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

MULTIPLE INSPECTION GAGES—See Gages, Multiple Inspection

MULTIPLE STATION MACHINES, Dial Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
National Automatic Tool Co., S. 7th N. St., Richmond, Ind.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 - 11th St., Rockford, Ill.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

MULTIPLE-STATION MACHINES, Transfer Type

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Baush Mch. Tool Co., 15 Wason Ave., Springfield, Mass.
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 124th St., Milwaukee 10, Wis.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Greenlee Bros. & Co., 2136 - 12th St., Rockford, Ill.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Road, Dearborn, Mich.
Moline Tool Co., 102-20th St., Moline, Ill.
National Automatic Tool Co., S. 7th N. Sts., Richmond, Ind.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Sundstrand Mch., Tool Co., 2531 11th St., Rockford, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

NIBBLERS, Portable Pneumatic

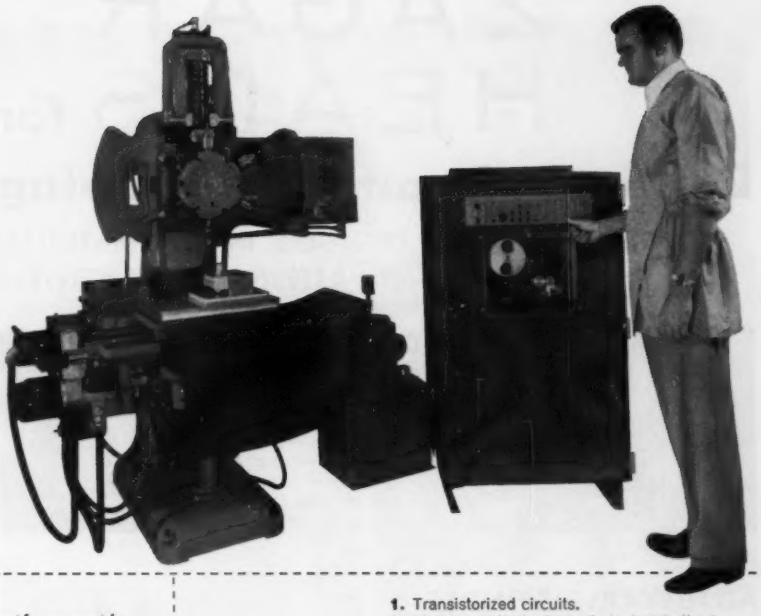
Buckeye Tools Corp., Dayton, Ohio

NIBBLING MACHINES

Wales-Strippit, Inc., Akron, N. Y.

NUMERICAL CONTROL SYSTEMS—See Electronic Control Systems

NEW! HUGHES 2-AXIS MACHINE TOOL CONTROL



The new Hughes Machine Tool Control provides you with automatic positioning of a two-axis table plus third axis feed control if desired. Designed for use in drilling, boring, turning, riveting, spot welding, punching, eyelet inserting and other similar operations, the Hughes Control offers you significant tooling and labor savings. It is easily adaptable to new machines or for retrofit.

advantages

1. Simplification of tooling reduces lead time.
2. Precision positioning eliminates expensive tooling.
3. Handling is reduced between operations.
4. High-speed operation reduces the number of machines required.
5. Scrap due to operator errors is reduced.
6. Very large savings are realized in re-run of any given parts order.
7. Eliminates large inventories.
8. Rework of tooling after design changes is replaced by simple modification of machine tape.
9. The new operator produces as much as the experienced operator.
10. Cost estimating is more precise.
11. The inspection burden is greatly eased. All parts are identical.
12. Planning and scheduling is greatly simplified. Many more operations can economically be performed with one machine and one setup.
13. Tape control means the machine delivers high precision work at the same cost as low precision work. Tight tolerances at no extra cost.

advanced features of the new Hughes Products 2-axis machine tool control

1. Transistorized circuits.
2. Mercury-wetted relays eliminate "chatter."
3. Positioning accuracy is ± 0.0005″, non-cumulative.
   Repeatable accuracy: ± 0.0002″.
   Input resolution: 0.001″.
4. Compact cabinet occupies minimum of valuable floor space.
5. Third axis of control easily added at nominal cost.
6. Electronic position transducer insures continuing accuracy and reliability.
7. Digital system assures positive, accurate, high-speed positioning at 180″ per minute.
8. Modular construction of plug-in units cuts down-time. Spare unit simply inserted for continuous production.
9. Standard 1″, 8-channel Mylar tape used in system.
10. Optical tape reader for precise, high-speed information input.
11. Tape is prepared on Hughes Products unit which is simple to operate and low in cost.

other specifications

Travel	Unlimited, except that the maximum movement per block of tape is 39.999 inches.
Axis Control	Two axes simultaneously.
Drive System	"Creep Traverse Drive Unit" to be attached to preloaded ball bearing leadscrew.
Tape	1 inch, eight channel, opaque, perforated tape.
Tape Reading Time	Less than one second during feed axis movements. Does not add to machining cycle.
Drive System Power	1/4 hp (higher power in special unit).
Resolution	0.001 inch.
Auxiliary Functions	24 bits of information available—programmable as six binary coded decimal digits.
Operation Modes	1) Automatic. 2) Set-up (semi-automatic for tape and program checking). 3) Manual.
Power Requirements	110 volt, single phase. Control plus drive motors require less than 10 amps.

For further information on the Hughes Machine Tool Control...and its application to your specific needs...please write or wire: HUGHES PRODUCTS, Industrial Systems Division, International Airport Station, Los Angeles 45, California.
For export information, write: Hughes International, Culver City, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

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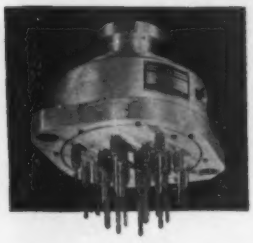
SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

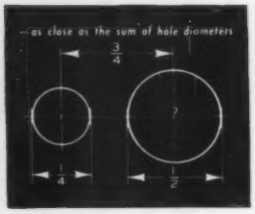
ZAGAR HEADS for Drilling · Reaming · Tapping

FOR ANY NUMBER OF HOLES, IN ANY MATERIAL, IN ANY PATTERN, ON ALL CENTERS



FIXED CENTER HEADS

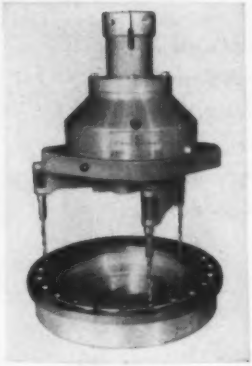
Up to 1500 holes can be drilled simultaneously by Zagar heads. In addition, Zagar can design "salvageability" into fixed center heads to give flexibility and changeability. Get Engineering Sheets 66-68-A.



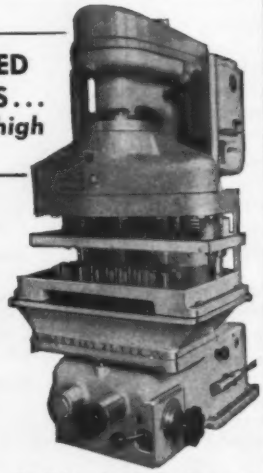
ADJUSTABLE SPINDLE HEADS feature:

no universal joints
no bulky gear clusters
no flexible shafts

Gearless drill head principles are incorporated in Zagar's exclusive adjustable spindle head. Adaptable on any standard drill press. Great flexibility within a bolt circle diameter of 23". Reworkability extends the life of Zagar heads to cover limitless jobs of varying hold patterns. Write for Bulletin 458.



COMPLETE, TOOLED "PACKAGE" UNITS... *for economical, high production.*



More holes at less cost per hole simply states the Zagar goal. Whether it is through special machinery, "packaged drilling", or one of many heads, Zagar engineers strive to increase your hole production at reduced cost. Illustrated are basic Zagar lines. From these emanate hundreds of individual solutions to meet the challenge — more profit at lower cost. From these hundreds of Zagar heads have been drilled millions of holes at costs of literally pennies per part. Send us your parts or drawings for a study of hole cost reduction.

Write for Engineering Manual M-11.

Drill head mounted on air-oil press, completely self-contained — all by Zagar.

23888 Lakeland Blvd.
Cleveland 23, Ohio

Zagar INCORPORATED
TOOLS FOR INDUSTRY and SPECIAL MACHINERY

NUT SETTERS—See Screwdrivers, etc.

NUTS—See Bolts, Nuts and Screws

OILERS AND LUBRICATORS
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Ill.
Madison-Kipp Corp., Madison, Wis.

OILS, CUTTING SOLUBLE—See Cutting and Grinding Fluids

OILS, Lubricating—See Lubricating Oils and Greases

OILS, Quenching and Tempering
Cities Service Oil Co., 70 Pine St., New York N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 - 5th Ave., New York, N. Y.
Standard Oil Co. (Indiana), 910 S. Michigan Ave., Chicago 80, Ill.

OPTICAL FLATS
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

PACKING, Leather, Metal, Rubber Asbestos, Etc.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

PAINTING EQUIPMENT, Spray—See Spraying Equipment, Metal

PARALLELS
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DoALL Co., De Plaines, Ill.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Walker, O. S., Co., Inc., Worcester, Mass.

PATTERNS, Wood and Metal
Mummert-Dixon Co., Hanover, Pa.

PILLOW BLOCKS
S K F Industries, Inc., Philadelphia, Penna.

PIPE, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
United States Steel Corp., National Tube Co., Div., 436 7th Ave., Pittsburgh, Pa.

PIPE AND TUBING MILLS, Electric-weld
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

PIPE AND TUBING, Brass and Copper
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Mueller Brass Co., 1925 Lapeer Ave., Port Huron, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.

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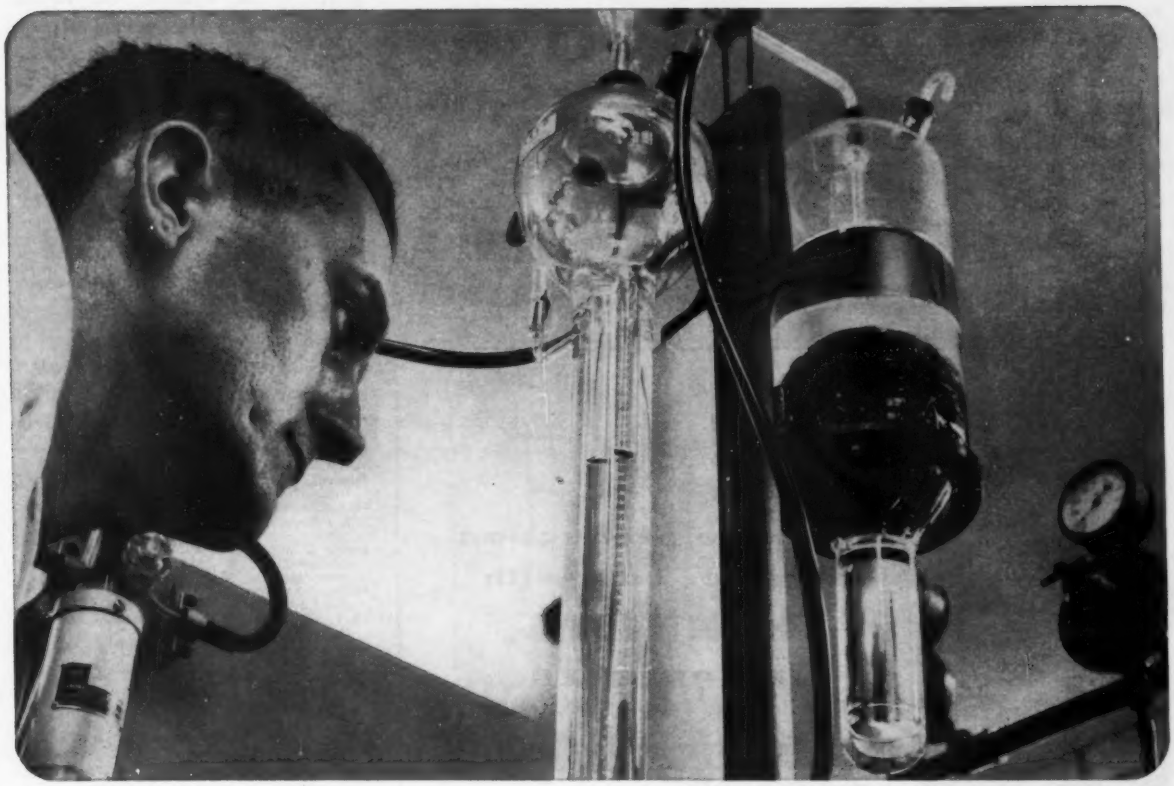

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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Gisholt Mch. Co., Madison, Wis.
U. S. Steel Corp., Nat'l Tube Div., Pittsburgh, Pa.

PRESS BRAKES—See Brakes, Press and Bending

PRESS FEEDERS, Automatic

Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
U. S. Tool Co., 255 N. 18th St., Ampere, East Orange, N. J.

PRESSES, Arbor

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
du Mont Corp., Greenfield, Mass.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Logansport Machine Co., Inc., Logansport, Ind.
Threadwell Tap & Die Corp., 16 Arch St., Greenfield, Mass.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Assembling

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Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lake Erie Machinery Corp., 470 Woodward Ave., Buffalo 17, N. Y.
Northern Hydraulics & Mach. Corp., Melrose Park, Ill.

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Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering Div. American Brake Shoe Co., 152 Dublin Rd., Columbus 16, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
U. S. Tool Co., Inc., 255 N. 8th St., Ampere, East Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach.. Co., Waterbury, Conn.
Wilson, K. R., Inc., Arcade, N. Y.

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Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
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Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Closed-Die Forging

Ajax Manufacturing Co., 1441 Chardon Rd., Cleveland 17, Ohio
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wilson, K. R., Inc., Arcade, N. Y.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Coining, Embossing

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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Minster Machine Co., Minster, Ohio
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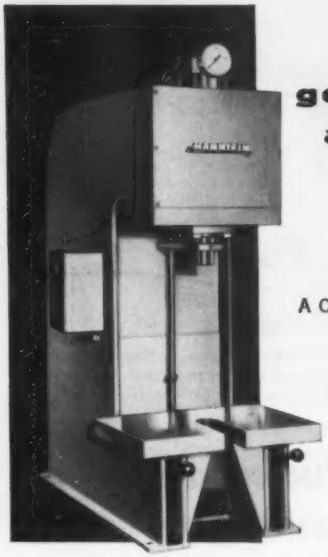
Verson Allsteel Press Co., 9309 S. Kenwood Ave. Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.



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Hydraulic Press Mfg. Co., Mount Gilead, Ohio
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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
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Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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Producto Machine Co., 985 Housatonic Ave., Bridgeport 1, Conn.
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Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Wilson, K. R., Inc., Arcade, N. Y.

PRESSES, Punching, Piercing
Allen, Alva Industries, Clinton, Mo.
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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(*Continued on page 296*)

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Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
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PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

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Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio

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Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

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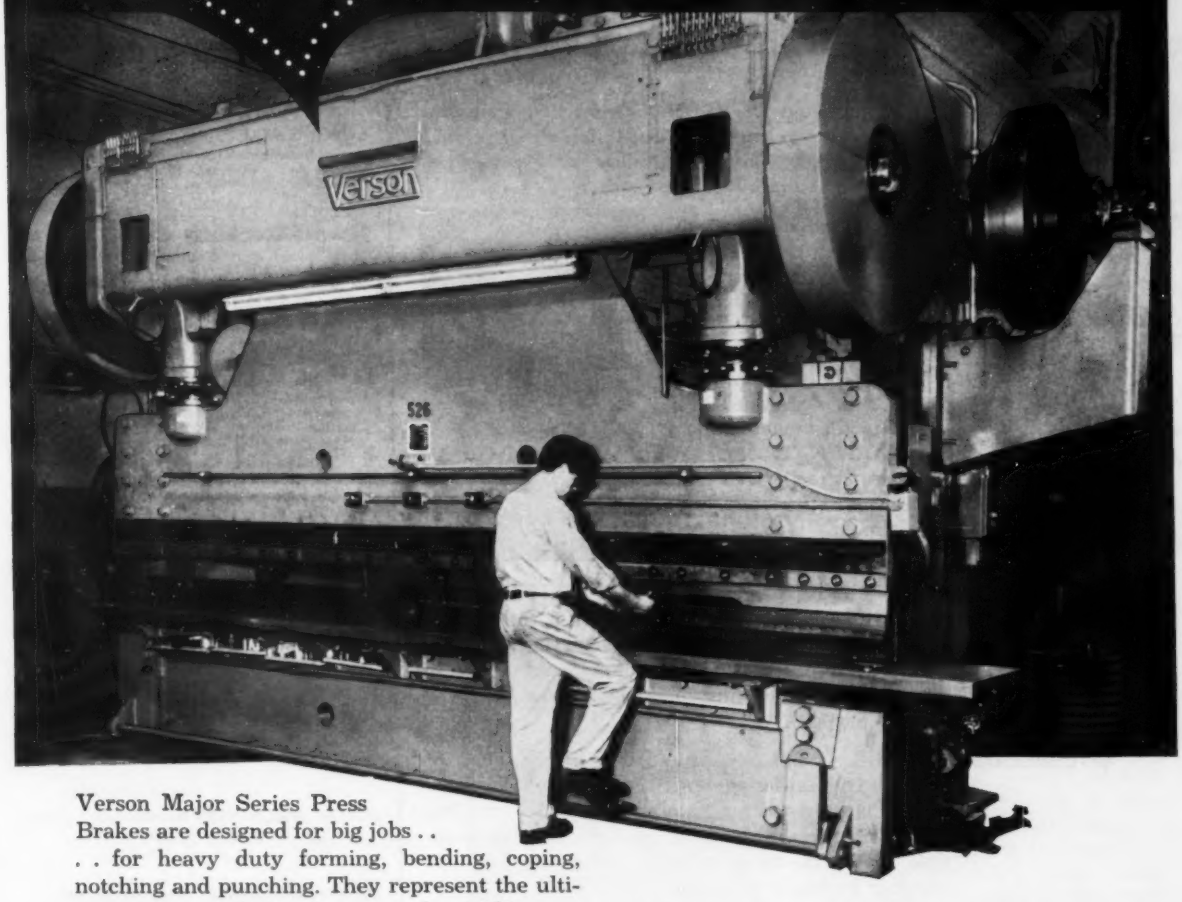

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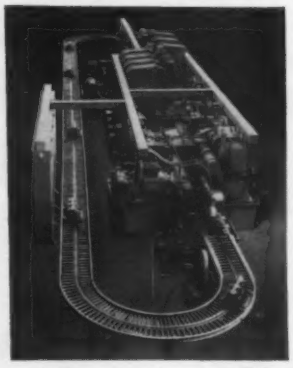
W-L CINCINNATI This 23-station Avey Line-O-Dex transfer machine, designed and built by The Avey Division of Motch & Merryweather Machinery Co., Cincinnati, Ohio, is equipped with spindles made of our HY-TEN "B" No. 2. This grade was chosen for its great tensile strength (100,000 P. S. I. in the natural condition), toughness, and fine wearing qualities.



W-L CAMBRIDGE We are now distributing FLEXANGLE, the easy-to-erect structure assembly for all types of racks, shelves, platforms, etc. It's completely universal and low in cost—can be used anywhere, by anyone, for any storage purpose.

W-L HILLSIDE Our stock of flat and square sizes in HY-TEN M Temper Oil Hardening Steel can save you time and money in your tooling program. HY-TEN "B" No. 3X pre-heat treated in rounds, squares and flats available in a wide range of sizes. Billets on hand for hammer forging in all grades of HY-TEN.

W-L CLEVELAND Excellent stock of brake die flats and squares. Also many sizes up to 16" x 18" in HY-TEN Mold Steel. Excellent deliveries.

W-L BUFFALO A wide range of rounds and hexagons in cold drawn AISI leaded and non-leaded A-4140. Also many sizes of the new "B" No. 3X-40 in rounds and hexagons.

Write our Cambridge office today for your *free* Wheelock, Lovejoy Data Sheets. They'll give you complete technical information on grades, applications, physical properties, tests, heat treating, etc.

WHEELOCK, LOVEJOY & COMPANY, INC.

AMERICAN STEEL WAREHOUSE ASS'N

138 Sidney Street, Cambridge 39, Mass.

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Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoALL Co., Des Plaines, Ill.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

SAW BLADE SHARPENERS
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

SAWING MACHINES, Abrasive Machines—See Cutting-off Saws, Abrasive Wheel

SAWING MACHINES, Band
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
DoALL Co., Des Plaines, Ill.

SAWING MACHINES, Circular Blade
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.

SAWING MACHINES, Power Hack
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

SAWS, Screw-slotting—See Cutters, Milling

SCREW DRIVERS, STUD AND NUT SETTERS, Power
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York N. Y.
Consolidated Mch. Tool Div., Blossom Road Rochester 10, N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SCREW MACHINES, Hand—See Lathes, Turret, Ram-type, Saddle-type

SCREW MACHINES, Multiple-Spindle Automatic
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
National Acme Co., 170 E. 31st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Scherr George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Warner & Swasey Co., 6701 Carnegie Ave., Cleveland 3, Ohio

SCREW MACHINES, Single-Spindle Automatic
Brown & Sharpe Mfg Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

SCREW PLATES
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

SCREWS, Cap, Set, Self-tapping, etc.—
See Bolts, Nuts and Screws

SEALS AND RETAINERS—Oil or Grease
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Illinois

SEPARATORS, Magnetic
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

SET-UP EQUIPMENT
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Lufkin Rule Co., Saginaw, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SHAPERS, Crank and Hydraulic
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Orban Kurt, Co., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

SHAPERS, Vertical and Slotters
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road Rochester 10, N. Y.
Orban, Kurt Co., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

SHEARS, Alligator
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio

SHEARS, Guillotine Bar
Beatty Machine & Mfg. Co., Hammond, Ind.

SHEARS, Rotary
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEARS, Squaring
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEET METALS—See Strip and Sheet, Ferrous, Non-ferrous

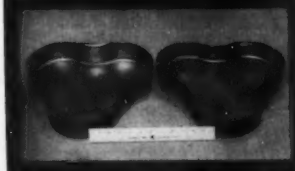
SHIM STOCK
Laminated Shim Co., Inc., Glenbrook, Conn.

SLITTING MACHINES, Rotary
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

SLOTTERS—See Shapers, Vertical and Slotters

LOOK WHAT YOU CAN DO WITH A BEATTY-QUICKWORK STAMPING TRIMMER

STAMPINGS before and after trimming



Trim — bead — form . . . up to 500 blank stampings per hour! The Beatty-Quickwork Stamping Trimmer is the versatile metal working machine that provides a short-cut method to speed the finishing of sheet metal stampings.

On either short runs or production jobs, this multi-purpose machine eliminates the need for expensive trimming dies — saves press time — requires minimum floor space. It trims even intricate shapes fast and accurately without burr; beads and forms in the same or separate passes.

Standard, heavy-duty and special models offer wide range of size and speeds — handle up to 3/8" mild steel.

ONE OF THE BEATTY FAMILY OF METAL WORKING EQUIPMENT: Shears, Punches, Presses, Spacing Tables, Bulldozers, Stamping Trimmers

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BEATTY MACHINE & MFG. CO.
941 150th St., Hammond, Ind.

SOCKETS—See Drill Sleeves and Extension Holders

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Barnes, John S. Corp., Rockford, Ill.
General Electric Co., Schenectady, N. Y.
National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Vickers Inc., Administrative & Engineering Center, Box 302 Detroit 32, Mich.

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Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 839 Green St., Ann Arbor Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keen, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Motch & Merryweather Machy. Co., 888 E. 70th St., Cleveland 3, Ohio.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Sheffield Corp., Box 893 Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

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Barnes, John S. Corp., Rockford, Ill.
Boston Gear Works, 320 Main St., North Quincy 71, Mass.
General Electric Co., Schenectady, N. Y.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio.

SPINDLES, Machine

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio

SPRAYING EQUIPMENT, Metal

Metallizing Eng. Co., Westbury, L. I., N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal

Laminated Shim Co., Inc., Glenbrook, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

STEEL ALLOYS—See Alloy Steels

STEEL, Cold Rolled, Stainless, High-speed, Tool, etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Tool Steel Co., Chicago Hts., Ill.
Jessop Steel Co., Washington, Penna.
Ryerson, Jas. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Timken Roller Bearing Co., Canton, Ohio.
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL DISTRIBUTORS

Ryerson, Jos. T., & Son, 16th & Rockwell Sts., Chicago 8, Ill.

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Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

Now

L&J

125 Ton Heavy Duty O.B.I. Press

STANDARD EQUIPMENT

Air clutch. Air-release, spring-set brake. J.I.C. wiring and controls. Solenoid—controlled dual air valves. Adjustable gibs with bronze or composition faced ways on slide. Hard bronze crankshaft bearings. One-shot forced lubrication. *Optional equipment as required.*

- **Completely new design in geared and non-geared types incorporates *proven* construction features.**
- **Exceptional rigidity insures long die life and close product tolerances..**
- **Large box-type slide mounted in long gibs holds accurate alignment.**
- **125 ton capacity covers wide variety of jobs.**
- **Big die capacity—bolster area 29" x 42"—shut height 18", or to suit.**
- **Versatile—efficient—dependable.**

WRITE for complete information on this new press. Also, 14 to 150 ton O.B.I. presses, 20 to 150 ton straight side presses, 30 to 75 ton gap frame presses.

L & J PRESS CORPORATION 1631 STERLING AVE. ELKHART, IND.

46% gain in production with BAKER®

ADJUSTABLE SPINDLE MACHINE

Standard Baker Vertical Adjustable Spindle Drilling Machine.

Cutting production time on an individual part from 6 minutes to 2 minutes, 47 seconds is typical of the production efficiency delivered by a new BAKER drilling machine at a leading manufacturer of power transmission equipment.

The average overall production increase is 46%.

It's flexible, too. Altogether 35 different parts are run across it.

For extra economy, BAKER design permits easy and quick maintenance.

This demonstration of BAKER speed and flexibility proves again that BAKER basic units are the foundation of today's most efficient drilling and tapping operations.

Perhaps *your* "special machine" problem can be solved by a BAKER standard vertical or horizontal unit fitted with the necessary components.

For the full story on these BAKER machines, write to: BAKER BROTHERS, INC., Dept. MH-1159, 1000 POST STREET, TOLEDO 10, OHIO.

NOW... COMPLETELY INTERCHANGEABLE

TO FIT 3 SIZES VERTICAL MACHINES		TO FIT 3 SIZES HORIZONTAL MACHINES
	21 ADJUSTABLE SPINDLE HEADS 27 FIXED SPINDLE HEADS 5 TYPES STANDARD TABLES	

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STANDARD AND SPECIAL DRILLING AND TAPPING MACHINES • COMPRESSION MOLDING MACHINES • AUTOMATIC BAR MACHINES

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Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
U. E. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

STRIP AND SHEET, Ferrous
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRIP AND SHEET, Non-ferrous
American Brass Co., 25 Broadway, New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Jessop Steel Co., Washington, Penna.
Ryerson Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STRUCTURAL SHAPES
Bethlehem Steel Co., Bethlehem, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

STUD SETTERS—See Screwdrivers, etc.

SUPERFINISHING EQUIPMENT
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.

SURFACE PLATES
Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.

SWAGING MACHINES
Cincinnati Milling Machine Co., Meta-Dynamics Div., Cincinnati 9, Ohio (Intraform)

SWITCHES, Limit
Allen-Bradley Co., 1331 So. 1st St., Milwaukee, Wis.

TACHOMETERS—See Indicators, Speed

TAPE CONTROL SYSTEMS—See Electronic Control Systems

TAP HOLDERS
Brown & Sharpe Mfg. Co., 235 Promenade St. Providence 1, R. I.
Burgmaster Corp., 15001 S. Figeroa, Gardena, Calif.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.

TAPPING HEADS
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Jarvis Corp., Stack Ave., Middletown, Conn.
Kato Mfg. Co., Osaka, Japan.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Leland-Gifford Co., 1425 Southbridge St., Worcester, Mass.
National Automatic Tool Co., S. 7th & N Sts., Richmond, Ind.
Thriftmaster Products Corp., 1014 N. Plum St., Lancaster, Pa.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio

TAPPING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Baush Machine Tool Co., 15 Wason Ave., Springfield 7, Mass.
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Cal.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
Cincinnati Bickford Div. of Giddings & Lewis Mch. Tool Co., Oakley, Cincinnati 9, Ohio.
Cross Co., P. O. Box 3835, Park Grove Postal Sta. Detroit 5, Mich.
Edlund Machinery Co., Cortland, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaufman Manufacturing Co., Manitowoc, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Landis Mch. Co., Waynesboro, Pa.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 2, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

TAPS, Hand, Machine Screw, Pipe, etc.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jarvis Corp., Stack Ave., Middletown, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio.
Threadwell Tap & Die Co., Greenfield, Mass.
Winter Bros. Co., Rochester, Mich.

TAPS, Collapsing
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.

COLUMBIA TOOL STEELS

For over fifty years COLUMBIA has built its reputation on tool steel that is good for you

Product of Skilled American Workmen

For more data circle Item 701 on Inquiry Card

Rowbottom for Cams

How a Cam was turned "Inside-Out"

The customer's requirements called for finer adjustment of the mechanism in which the cam labelled "Before" was being used on a nylon winding machine. In this cam only one roll was used to run in the groove of the cam. Exactly the same motion was accomplished in the cam labelled "After" by literally turning the cam inside-out and employing two rolls to run on opposite sides. Requirements as to adjustment were fully met.

BEFORE:
"Female" Cam using only one roll.

Jobs like this are every day problems faced and met by Rowbottom. Perhaps you have a problem in cam production which comes within the scope and experience of Rowbottom. It may well be worth your while to submit your requirements. Send us your specifications. Ask for an estimate on any type cam in any quantity; also on rotary profiling.

AFTER:
"Male" Cam using two rolls.

The ROWBOTTOM MACHINE CO.
WATERBURY, CONN.

For more data circle Item 702 on Inquiry Card

is this the one best cutter for low cost MILLING ?

We happen to know it is—on this specific job!

But frequently operators will rely on "pet cutters" for milling a variety of parts and materials. Result: Either higher costs or inferior finish . . . and usually both.

The problem has always been to match the cutter *exactly* to work and machine on every job.

Solutions to problems like these are our main product. And only after a penetrating study of machine, work, depth of cut, speed, feed rates and finish requirements do we recommend any cutter.

The inserted blade cutter pictured above is an example. On the work and the machine for which it was designed it is "the one *best* cutter for low cost milling."

We would welcome the opportunity to tell you more about this unique cutter selection service. Write:

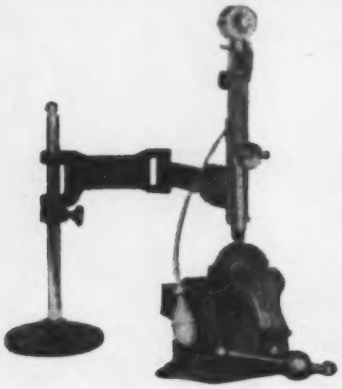
This helpful new booklet tells you how to reduce the cost of chips and improve your milling and boring performance. Ask for a free copy of booklet No. 68B.

THE
INGERSOLL
MILLING MACHINE COMPANY
CUTTER DIVISION
505 FULTON AVENUE • ROCKFORD, ILLINOIS

For more data, circle this page number on inquiry card

"SHORE for SURE"

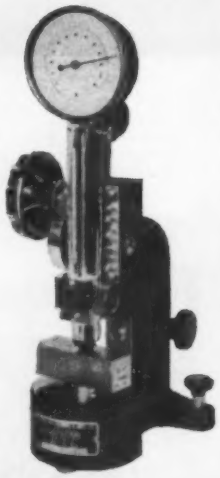
HARDNESS TESTING



Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.

Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 2½" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.



THE SHORE INSTRUMENT and MANUFACTURING Co., Inc.
90-35 Van Wyck Expressway, Jamaica 35, N. Y.

For more data circle Item 703 on Inquiry Card

TESTING EQUIPMENT Air, Oil & Water Pressure
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

THREAD CUTTING MACHINES
Davis & Thompson Co., 4460 W. 124th St., Milwaukee 10, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD CUTTING TOOLS
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Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

THREAD ROLLING DIES—See Dies, Thread Rolling

THREAD ROLLING EQUIPMENT
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National Acme Co., 170 E. 131st St., Cleveland 3, Ohio.
National Machinery Co., Tiffin, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

TOOL CONTROL BOARDS
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Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

TOOL MATERIAL, Ceramic
Metal Carbides Corp., Youngstown 12, Ohio.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Vascoloy-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
du Mont Corp., Greenfield, Mass.
Jessop Steel Co., Washington, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

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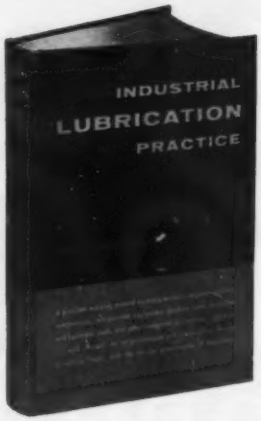

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3. **Table, parallel to turret within .001".**
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5. **Spindle taper (internal) runout within .0002" at spindle nose.**
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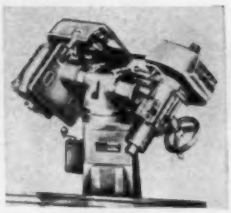

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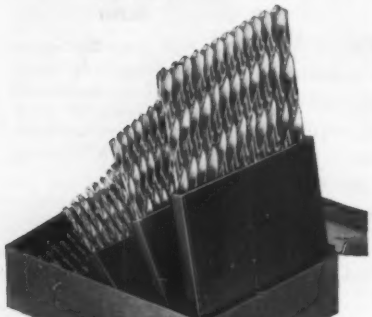

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Logansport Mch. Co., Inc., Logansport, Ind.
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Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
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Elmes Eng. Div., American Steel Foundries, 1150 Tennesee Ave., Cincinnati 29, Ohio
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
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Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
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Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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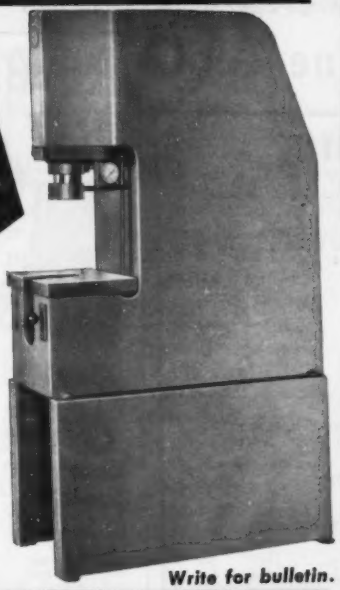

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No. 164-1/2 Toledo Toggle Drawing & Deep Stamping
7½ ton French Oil Mill Machine Co. Straightening, m.d., 1942
100 ton Wood Model 8229 Vertical Hydraulic, 4 col. single action-down
300 ton Chambersburg Hydro-Pneumatic Wheel, m.d.
600 ton Niles Horizontal Wheel Press
Type 8750 Hennifin Hydraulic Straightening, m.d.
Model H Cleveland O.B.I. Punch Press, belt drive
No. 3AA Canco (American Can Co.) Open Back Inclinable Punch Press, m.d.

PROFILERS

No. 12B Pratt & Whitney Model 1693, 2 spindle, 1944
No. 12M Morey, 2 spindle m.d., 1943
4 spindle 360° Cincinnati Automatic, m.d., 1944
30" capacity 2 spindle Pratt & Whitney Vertical Miller & Profiler, Model 1482

PUNCHES & SHEARS

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No. 7 Thomas Vertical, latest

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52" Betts Hydraulic Feed Car Wheel Borer, & Facer, belt drive
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No. 4XB Robertson Economy, m.d., new
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Model 401 Cutomatic Abrasive Cut-off, m.d.
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6" Pratt & Whitney M1506, Model B Vertical
12" Rockford Universal Hydraulic, flanged m.d.
12" Hendey Universal Back Geared, m.d.
24" Gemeo Standard Duty Universal, m.d.
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24" Rickford Hydraulic, m.d.
32" Morton Draw-Cut, m.d., late
32" Cincinnati, m.d., late
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Model 1236 Libert High Speed Nibbler Type Shear, m.d.
No. 5 Hilles & Jones Pyramid Type Bending Roll
Model U1144B Pexto Underdriven Power Squaring Shear
Model SP Dreis & Krump Hand Type Box and Pan Brake
8'x10 gauge Pexto Shear, m.d.

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20" stroke Rockford, m.d.
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No. 10 Model 2100 Warner & Swasey Bench Model, m.d.

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No. 1 Warner & Swasey "Electric", m.d., bar
No. 18-25 Acme Saddle Type, m.d.
No. 1L Gisholt Universal, m.d., 1943
No. 2 Bardons & Oliver Ram Type Electric, m.d.
No. 2A Warner & Swasey, 1946
No. 2H8, Libby, 1942
No. 3 Gisholt, m.d., 1945
No. 3A Warner & Swasey, m.d.
No. 3 Bardons & Oliver Ram Type, flanged m.d.
No. 3L Gisholt, m.d., 1943
No. 3AL Gisholt, with cross sliding turret, 1940
No. 4 Midland Universal Ram Type, m.d.
No. 4 Warner & Swasey Universal Ram Type, m.d.
No. 4 Gisholt, 1943
No. 4A Warner & Swasey Universal Hollow Hexagon, m.d.
No. 4A Warner & Swasey Universal, m.d., chucking, 1939
No. 4L Gisholt Universal, m.d.
No. 4FU Foster Fastermatic, m.d., latest, 1945
No. 4H-12 Libby, m.d.
No. 4R Libby Ram Type, m.d. in base
No. 5 Midland, m.d.
No. 5 Gisholt, Ram Type, m.d.
No. 5L Gisholt, 1946
No. 6.2 Denver Acme Ram Type Universal, m.d., 1944
No. 7 Bardons & Oliver, m.d.

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No. 2K Kearney & Trecker, m.d.
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No. 4 Cincinnati H.S., Dial Type, m.d.
No. 4K Kearney & Trecker, m.d.
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36"x36"x20' table Cincinnati H.P. Double Housing, m.d., belted
48"x48"x18' Niles-Bement-Pond, 2 heads, belt
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Auto: 2" RB6 Acme-Gridley, 1944
Auto. Chucker: 6½" No. 665 New Britain, 1943
Balancer: Tinius Olsen prop. shaft, 1948
Borer: DB1212A Ex-Cell-O, 1949
Boring Mill: 4" bar Universal, 60" vert., 1942
Boring Mills 5" Sellers 60" vert., 1941
Broach: 10 ton 54" American vert. duplex
Centering: 6" x 72" No. 56 Sundstrand
Compressor: 868 CFM Sullivan duplex, 125 HP
Drill, Deep Hole: 420 W. F. & John Barnes, 1942
Drill, Multiple: No. 4BL Nateo, 36 spdl.
Drill, Upright: 21" Cin. Bick. 1L superservice late
Drill, Radial: 4 11" Carlton, 1941
Drill, Hydr.: No. 25 Ex-Cell-O, late
Gear Hobber: No. 3 Barber Colman, late
Grinder, C'less: No. 12 Landis, 1948
Grinder, C'less: No. 2 Cincinnati, Simatic, 1940
Grinder, C'less: No. 2 Cincinnati, Simatic, 1951
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 171 Heald sizematic, 1952
Grinder, Int.: No. 271 Heald plain, 1951
Grinder, Int.: No. 74 Heald, 1941
Grinder, T&C: No. 2 Cincinnati, 1944
Grinder, Univ.: 10x24 Landis, late
Lathe, Auto.: 8 x 15" Sundstrand
Lathe, Auto.: No. 8 Gisholt, 1950
Lathes: 13 x 15", LeBlond Regal, 1956
Lathe: 16" x 54" American Pacemaker, 1941
Lathe, Engine: 24" x 120" Monarch Model CM, 1943
Lathe: 25" x 72" Axelson, 1944 also 25" x 18
Lathe: 60" Lodge & Shipley "T" 1954
Lathe, turret: 9½" Hole No. 4L Gisholt
Lathe, turret: No. 4 J & L, prest. 1942
Mills, Boring: 60" Gisholt, vert. 9CG
Mill, Boring: 100" Niles vert. PBT
Mills, Prd.: No. 33 Sundstrand Fluid-Screw, 1942
Mills, Prd.: No. 5-4B Cincinnati, late
Mill: No. 5H K&T, plain, vert. hd., 1941
Mill: No. 3KM K&T vert., 1943
Mill: 42" x 42" x 18" Ingersoll planer type
Planer: 66" Rockford Hydr. open side, 1941
Press: 110 ton No. 675B Bliss, high speed
Press: 125 ton Clearing SS crankless, 1943
Press: 150 ton Lake Erie hydr. 1951

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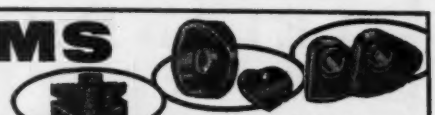

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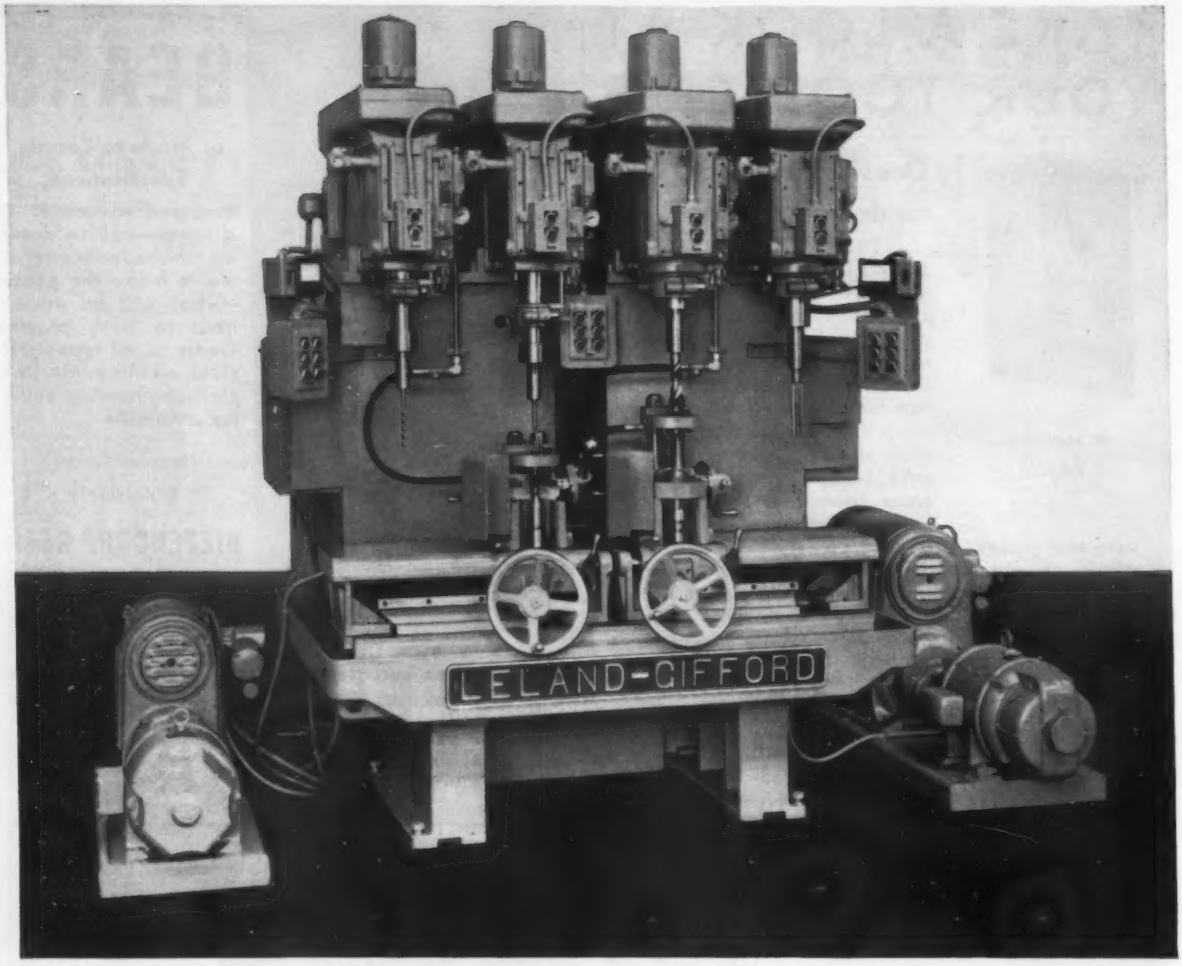

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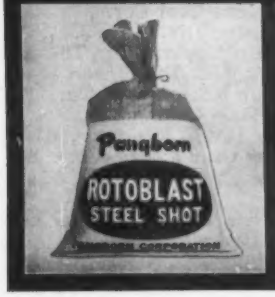

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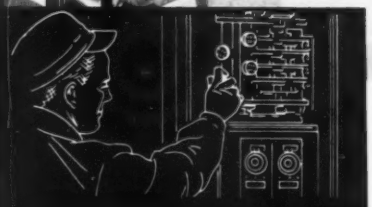

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